ELECTRICAL REVIEW

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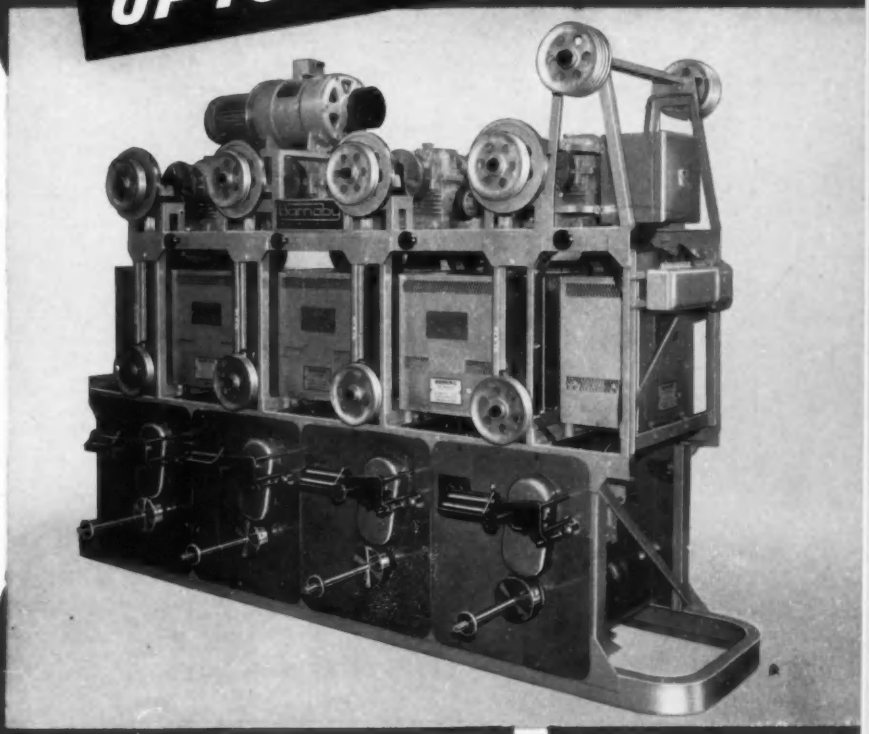

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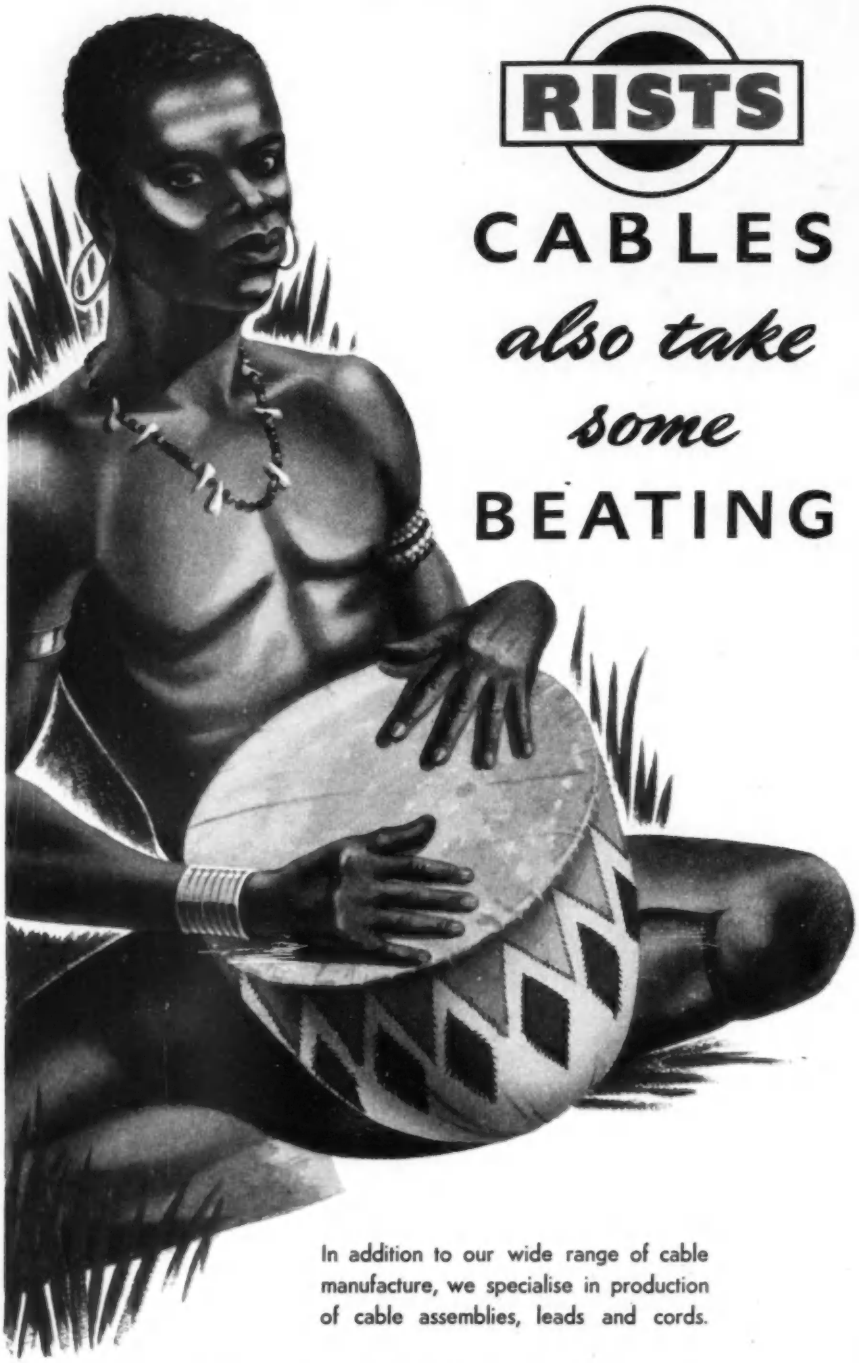

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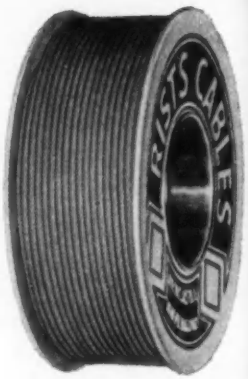

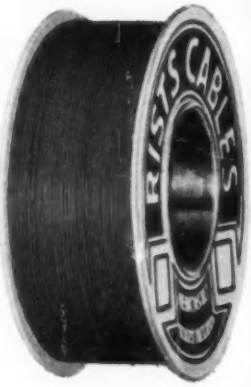

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ELECTRICAL REVIEW

9 January 1959 Vol. 164 No. 2 Established 1872

Geothermal Power Generation

THE modern view which ascribes the source of exploitable Earth's heat to localised concentrations of radioactive elements in the upper crust rather than to the molten centre has given new impetus to attempts to use this form of waste heat for the generation of electricity on a major scale. Prospecting to this end is now being carried out in several countries where important geothermal manifestations occur and some particulars of this were given at the recent World Power Conference (Canadian sectional meeting) by Messrs. T. G. N. Haldane, B. Wood and H. C. H. Armstead (all of Messrs. Merz & McLellan), who also discussed the underlying theories and economic aspects in the light of the knowledge now available.

Only two examples exist of the use of geothermal steam to a significant extent for power production. The first is the 300 MW plant at Larderello in Italy (including a 120 MW power station built since the war), which has been developed during the past half century or so and is reported to be a highly profitable undertaking. The second is the 150 MW installation authorised at Wairakei in New Zealand (North Island), where the first 30 MW set has just been commissioned.

Widely varying seismic conditions in different regions prevent the drawing of general conclusions at present in regard to such matters as pressure, wetness and gas content of the steam. It appears, however, that no borings are likely to be of commercial value unless they strike a fissure. Capital expenditure (excluding prospecting and electrical transmission) on a new scheme of 250 MW is estimated by the authors of the paper at probably £55 to £85/kW generated, of which 60 to 70 per cent would be on account of power stations. The balance would be spent on boring and steam transmission from the well-heads. Steam conditions seem inherently low. At Larderello the working pressure of slightly superheated steam from the best of 116 bores (12in diameter at bottom) going down 1,000ft is 70 lb/sq in after being transmitted 1½ miles. In New Zealand a working pressure is obtainable of 214 lb/sq in from 7⅝in bores 2,000ft deep.

Improved results will no doubt follow the accumulation of knowledge and experience. This is illustrated in New Zealand by the increase in the

number of successful bores; initially these formed only 50 per cent of the total, but nearly all are now reported to be good yielders. Since the total heat loss from the Earth is believed to be equivalent to ten times the heat consumption of all electricity generating stations in the world today, the possibility of using a greater part of it warrants a continuation of the serious study given to the subject in the present instance.

B.E.A.M.A. DIRECTORSHIP

A great many people in the electrical industry will learn with regret of Col. B. H. Leeson's decision to retire from the directorship of B.E.A.M.A. later this year, a position he has held with distinction since 1946. In those twelve years Col. Leeson has handled with great skill and tact many formidable problems—not the least those connected with the Monopolies and Restrictive Trade Practices Acts.

His successor as director of B.E.A.M.A. is Mr. S. F. Steward who is best known for his work at the Ministry of Supply during the 1939-45 war and as chairman of the South Western Electricity Board where he was responsible for great electrical advances in a difficult area. His experience of the manufacturing industry is a lengthy one and he knows, and is known to, most of the leading electrical people. We wish Col. Leeson happiness in his retirement and Mr. Steward success in his new position.

BOILER FUELS

During 1958, the Central Electricity Generating Board commissioned four new oil-fired boilers and a further 28 boilers were converted from coal to fuel-oil firing. For these 32 boilers the total evaporative capacity is 13,390 klb/hr. This would produce about 1,600 MW. It is interesting to compare these figures with the total coal-fired boiler capacity commissioned during 1958, namely 6,910 klb/hr. That is, the amount of new and converted oil-fired plant is double the amount of new coal-fired plant commissioned.

On 20th December last, the Coal Board's stock pile was nearly 20 million tons, the bulk of which was suitable for power station use only. Assuming 100 per cent load factor, this coal would provide sufficient fuel for the 32 oil-fired boilers mentioned above for about three years' operation. As Mr. A. M. F. Palmer indicated during a recent parliamentary debate on the coal industry, there is a very good case for a reversion to coal firing in power stations which are at present burning oil. It would seem that further increase in the capacity of oil-fired plant is hardly in the national interest when coal which is virtually useless except in power stations is piling up at the pithead.

RESUSCITATION FROM SHOCK

The Ministry of Labour and National Service report on electrical accidents during the year 1957 indicates a reduction in both fatal and non-fatal accidents. This is very encouraging, but while in the cases of 30 fatal accidents involving electric shock nine artificial respiration crews worked for over an hour to save their colleagues, fourteen crews gave up after efforts lasting from a few minutes to less than an hour. As the report says, it is distressing that they did not follow the constantly repeated advice to persist for several hours in the hope of saving life.

The value of training factory personnel in artificial respiration cannot be too strongly emphasised, and the knowledge so imparted is as useful at home as at work. It is fortunate that in the non-fatal cases of electric shock only about 10 per cent were rendered unconscious and the majority of injured persons were revived after artificial respiration of a few minutes up to half an hour. The figures given in the report show that the proportion of fatalities was 6 per cent of the total number of electrical accidents, excluding the relatively unimportant cases of eye-flash. When compared with other kinds of accident in the factory, however, this would seem to be a high proportion.

NEW YEAR HONOURS

Once again the electrical profession and industry are not over-represented in the New Year Honours List. The knighthood conferred on Mr. I. J. Hayward is mainly in respect of his position of Leader of the London County Council although he is also the active chairman of the London Electricity Consultative Council and therefore a member of the Electricity Board. Col. Donald McMillan, director of external telecommunications, G.P.O., already an O.B.E., is made a C.B. Another Post Office man honoured is Major H. A. Ashdowne, director of the North Western Region, who becomes a C.B.E. Other new Commanders of the Order are Messrs. L. T. Morton (Clarke Chapman & Co.), J. A. Ratcliffe (M.O.S. Scientific Advisory Council), J. H. Reed (Ericsson Telephones) and J. McW. Storey (Dewrance & Co.). There are a few electrical names among the O.B.E.s and M.B.E.s. and about twenty British Empire Medals have been awarded to people in various branches of the industry. We offer our congratulations to all those who are included in the list.

CONFUSED PAY PROBLEM

When it was announced last May that the manual workers in the electricity supply industry were to be paid a " productivity allowance " of 8s 3d a week we thought that it was a rather strange innovation. We also thought that it would not be considered by the trade unions to affect in any way their periodical claims for higher wages. This proved to be the case for recently the unions asked for an increase to meet the rise in the cost of living since basic rates were added to in March, 1957. The claim was rejected and now the unions have made a protest to the chairman of the Electricity Council and the Central Electricity Generating Board.

It has been reported that the rejection was based on the argument that the unions, by accepting the productivity allowance in May, had, by implication, debarred themselves from claiming any further increase because of cost-of-living rises before that date. If this is true, we feel that the Electricity Boards are not on very firm ground. The unions have some reason for maintaining that there is a distinction between " productivity " pay and cost-of-living rises.

Nuclear Power Plant Auxiliaries

The design of the electrical system for supplying auxiliaries in a nuclear power station differs considerably from that in a conventional fossil fuel fired generating station. This is mainly because of the safety requirements for the reactors and also the high power of the coolant circulator motors. This article describes the requirements for a nuclear power plant electrical system and deals with the method of supplying the circulator motors, and reactor essential supplies

ELECTRICAL SYSTEM DESIGN CONSIDERATIONS

By W. JOHNSON*

IN the nuclear power stations now under construction for the Central Electricity Generating Board the source of power in each case is two reactors, with six or eight boilers per reactor. The power output to the grid system varies from 275 MW to 500 MW, and this is generated in two cases by six turbo-alternator sets and for the lowest output by four sets. If it is assumed that any further stations will have an output of at least 500 MW then it is likely that there will be at least six sets. From an assessment of existing designs it would seem therefore that the most likely requirement for a 500 MW station is two reactors, each with six boilers, and six sets, and this article is based on that assumption.

The electrical philosophy for a nuclear station differs considerably from that applying to a fossil-fuel-fired station. This is due in the main to the safety requirements for the reactors, and also to the large amount of power required by the gas circulator motors.

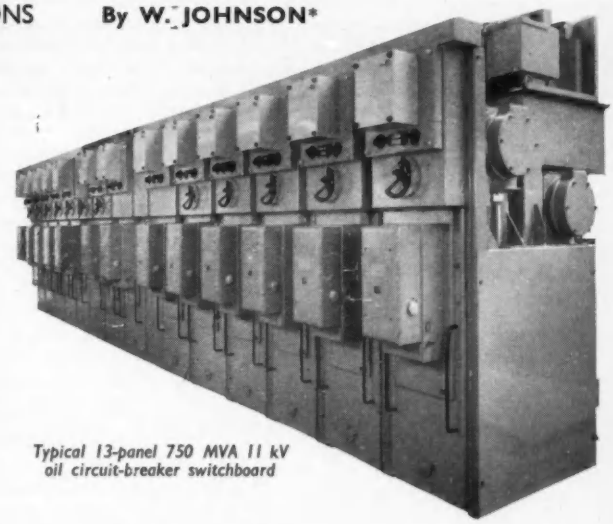
In conventional stations it is the accepted practice to operate on a unit principle, but in a nuclear station each reactor is supplying three sets. Complete flexibility can be attained on the steam side by working both reactors together on the range principle. It is difficult to line up the electrical system operationally to this scheme, but it must be sufficiently flexible to be able to operate one set from one reactor with the other two shut down.

Before the electrical system can be designed the method of controlling the gas flow through the reactors must be decided. The methods used in the stations under construction have resolved themselves into two basic differences in the method of supplying the circulator motors. These are:—(a) separate variable-frequency house sets generating at 6·6 kV or 11 kV supplying the circulator motors only, and (b) a unit/station source of supply. It is not proposed to discuss the merits of the types of drives but to look at them from a system point of view.

Variable-Frequency Supply

Fig. 1 shows a typical scheme where no transformer is used between the auxiliary sets and the circulator motors. The only transformers to be considered are the unit and station transformers. The unit transformer should be capable of supplying the normal load and therefore presents no problem, but the station transformer is different. There are two things to consider:—(a) the higher voltage would probably be 275 kV, and (b) the load required for testing.

* Chief Electrical Engineer, Atomic Power Constructions, Ltd.



Typical 13-panel 750 MVA 11 kV oil circuit-breaker switchboard

If 275 kV is to be used for the transmission voltage then the minimum economic size of transformer would be 15 MVA considering 3·3 kV or 6·6 kV as the secondary voltage. This means that using two station transformers in parallel the maximum load which can be sustained continuously is 30 MVA. There is, however, a further consideration. It is thought that the pressure vessel and the gas circuit will have to be tested on full load. It is not considered feasible with this scheme to have a portable boiler of rated capacity to operate the motors via the variable-frequency sets, so the testing must be carried out through station transformers. The motors on this scheme would be squirrel cage, about 8,000 h.p., having a starting current of 4½ times full load and, allowing a volt drop of 15 per cent on starting, the minimum size of station transformer would be 25 MVA. This size eliminates 3·3 kV switchgear owing to the high current rating so that either 6·6 kV or 11 kV switchgear would have to be used. This would obviously fix the voltage on the secondary side of the transformer and also of the h.v. auxiliaries.

Circulator Switchgear

For a 500 MW station the size of the circulator motors is appreciably higher than those announced for the smaller stations. Considering six motors per reactor then the total power required would be about 35 MW. Fig. 1 shows a proposed switchgear system and the requirements are that it must be possible to parallel any two sets on to any reactor board and to shut down any one circulator

motor and start up again without affecting the other motors.

The switchboard has double busbars, but the bars are not "back-up" to each other as they are both operating on full load. One bar is utilised to supply a secondary busbar feeding the motors of one reactor and the other bar is similarly arranged for the motors of the other reactor. This is necessary to ensure that the speed of the motors on each reactor can be varied independently. Both secondary busbars are connected to the main bars via isolating switches which will always be operated off load. All alternators and both secondary busbars can be connected to either of the main busbars by means of the isolating switches.

There is complete flexibility with the scheme except perhaps for a busbar fault. When it is considered that at least one set of bars at any one time is always alive throughout the life of the station it may be thought necessary to sectionalise the busbars. This would mean a costlier scheme and complication in operating procedure. It should be noted, however, that should one busbar fail then it will obviously shut one reactor down, but it would be possible to get that reactor back again by connecting it to the same busbars as the running reactor. This would probably mean reduced station load depending on the capacity of the switchgear, but it would be possible to run the two reactors although the speed control for both sets of motors would be the same.

The minimum breaking capacity of the switchgear must be sufficient to withstand a fault due to two alternators and the motors of one reactor, or two reactors if it is considered that it is feasible to run both from one busbar. Assuming an alternator rating of 35 MW (plus motor efficiency) with a sub-transient reactance of, say, 10 per cent, and a total motor load corresponding to the sets, then the total fault level would be over 800 MVA. This is very high for power station auxiliaries although the level could be brought down by connecting electrical reactors in the circuit either for paralleling only or for permanent connection.

A further consideration is that the speeds of the sets vary and a figure quoted for this speed range is 20 per cent to 100 per cent. This means that the switchgear must be capable of breaking maximum fault current at any frequency down to 10 c/s. This is obviously a switchgear design problem which can be overcome by certain means, but in addition it is a testing problem in as much as the fault current at 10 c/s must be available to test the switchgear to the customer's satisfaction.

The 415 V system can be conveniently divided electrically into two sections, viz. turbine house section and reactor section. The turbine house section contains those auxiliaries associated with the turbines and other conventional plant such as the c.w. system, workshops and amenities block. These can be fed in a conventional way as shown on the diagram.

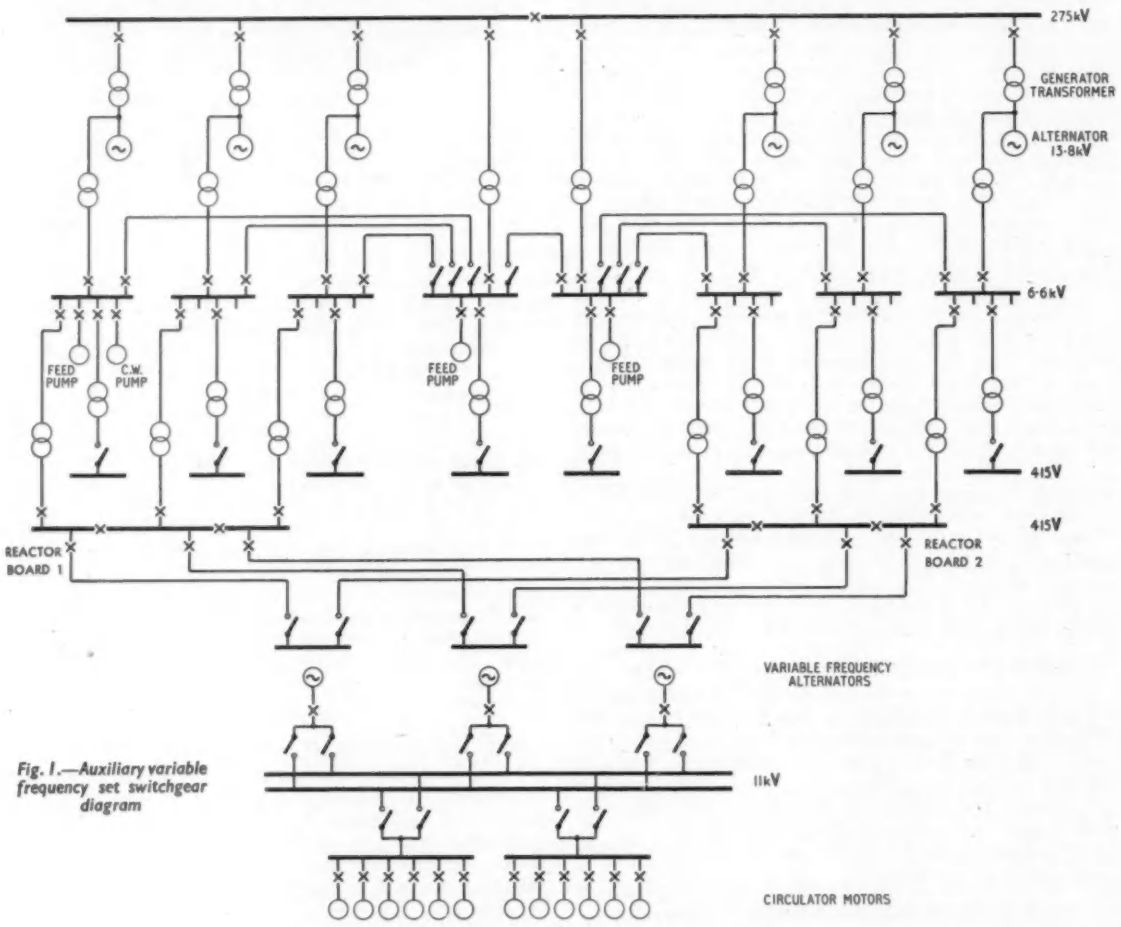


Fig. 1.—Auxiliary variable frequency set switchgear diagram

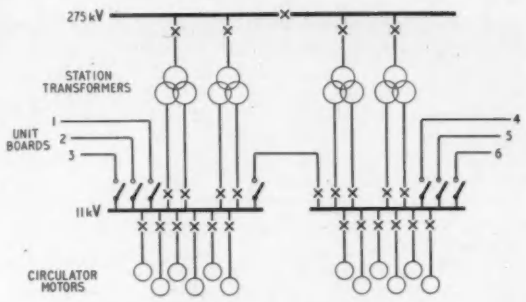


Fig. 2.—Station supply scheme

The reactor area is that which is enclosed by a safety fence, and such items as the cooling pond, decontamination building, CO_2 storage, etc., can be within that area. The auxiliaries here are associated with the reactor only, and as each reactor supplies three main sets it is convenient for the auxiliaries to be fed from central boards, these boards being shown on the diagram as reactor boards 1 and 2. There are different methods of supplying these boards, and Fig. 1 shows a proposed scheme whereby a supply from each unit is taken via transformers. The transformers will be rated about 2 MVA which necessitates the 415 V board running with the bus section switches open to keep the fault level down.

The auxiliaries for each reactor can be conveniently divided into functions or areas as the case may be, and the boards supplied from the main reactor board. There are, however, certain safety precautions which must be taken and these are dealt with later.

The auxiliaries for the variable-frequency sets are in a different category from the other auxiliaries. They cannot be fed from their own sets due to varying frequency and therefore they must be fed from either a station or a unit source. There is, however, a further consideration. Fig. 1 shows that three variable-frequency sets are required, two running normally and one for maintenance. It is necessary for each set to be able to supply the circulator motors on either reactor and it is pertinent that the auxiliaries of any set which is supplying the motors of any reactor should be fed from the same source as the auxiliaries of that reactor. This means that a suitable system for supplying the house set auxiliary boards must be devised.

There are several ways of doing this and Fig. 1 shows a proposed scheme. As stated above, the reactor board controls all the auxiliaries for the reactors and if that board loses its supply then the reactor will shut down. If this happens then the main circulator motors and the variable-frequency sets can be shut down. It is therefore feasible to connect the house set auxiliary boards from the reactor boards, and also to interconnect them between reactor boards 1 and 2 as the diagram shows. This is done so that any set feeding a given reactor can have its auxiliaries fed from that reactor board. The incoming isolators are interlocked to prevent paralleling incompatible supplies.

When considering the reasons for putting forward variable-frequency sets it should be remembered that if the above method of supplying the set auxiliaries is used then the reliability of the house sets depends amongst other things entirely on the normal unit/station supplies. To obviate this, supplying these auxiliaries from a d.c. source may be considered. The system used could be important as the sets require separately driven exciters.

One of the conditions laid down for the safety of the reactor is that if two circulator motors fail simultaneously then the reactor control rods must drop in to shut the reactor down.

Before deciding the method of supplying a load of 35 MW of motor power from a source other than a separate variable-frequency set, there are three practical methods to choose from:—(a) unit supply only, (b) station supply only, and (c) combined unit/station supply.

With six circulator motors and three unit boards two motors can be conveniently supplied from each board. This is a satisfactory method if the failure of a set is not considered. Unfortunately, this cannot be ignored as the loss of two circulators would shut the reactor down. A means of overcoming this problem is automatic switching to the station supply on loss of unit volts. Electrically this is simple, but temperature and gas flow transients in the reactor must be taken into account.

Each motor represents about 6 MW of load and it is not thought feasible to switch motors of this size on to a supply until the flux has died down. This may take as long as seven seconds and when this is added to the time taken to get up to top speed again the temperature rise in the reactor may be too high to allow this procedure. For safety reasons a run-down time from full speed to half-speed of about 30 sec is laid down. To achieve this it may be necessary to put in a flywheel which, of course, lengthens the run-up time to top speed. A further point worth noting is that on switching direct to the station supply the volt drop will be appreciable and the design of the motor must be such that it can develop sufficient torque to accelerate the blower to full speed.

When operating from the station supply only, then for each reactor two 100 per cent duty transformers are required as shown in Fig. 2. The obvious comment on this scheme is the apparent unreliability of the supply to the motors due to the susceptibility of the 275 kV systems to faults. It must be noted, however, that if the 275 kV lines are lost, the load is lost and the reactor must be shut down on any scheme unless the lines can be brought back again quickly; but whether the reactor should shut down entirely or just reduce power is a function of the design of the steam circuit and the temperature transients. If it is necessary to shut down on loss of station output then the station supply scheme is no worse than any other scheme, but if the reactor power can just be reduced then the scheme is unsatisfactory.

A proposed scheme of combined unit/station supply is shown in Fig. 3 and it will be noticed that a very unusual

This type of 415 V air-break switchgear is available with ratings up to 30 MVA (Crompton Parkinson)

feature here is the proposal to run both unit and station boards permanently paralleled on the l.v. side. This is done for safety considerations. This method is the most satisfactory from a design and safety point of view, but operationally would be more difficult than (a) or (b).

It will be seen from Fig. 3 that two circulator motors are fed from each unit board and that each unit board is connected to the station board via electrical reactors so that the unit and station boards are running permanently connected. This method gives the most reliable supply to the motors under all possible fault conditions, but operationally raises a number of problems.

The sets will be paralleled and operated according to 275 kV requirements so any voltage fluctuations, phase angle differences and speed variations cannot be compensated for on the 11 kV side in the normal way. It is thought that for a steady load there may be power circulating around the circuit, but that it could be kept within practicable limits. Should power surges occur due to transmission faults or a set tripping out, then the transients on the 11 kV side would cause an excessive flow of circulating power.

The voltage of the system can be kept fairly constant by having automatically operated tap-changers on the unit transformers, the taps being as fine as can be obtained. The station voltage would act as the reference voltage and each unit transformer would monitor against this voltage.

It is also thought that should a set's 275 kV breaker trip for any reason, then the corresponding 11 kV breaker should trip also, the supply to the unit board being taken over by the station supply. The voltage drop in the system by doing this would cause less disturbance than the instability of the set following loss of load if the set's 275 kV breaker tripped and the 11 kV unit breaker did not.

Transformer and Switchgear Ratings

The size of the transformers for any scheme more or less determines the voltage and the rating of the switchgear to be used when there is such a heavy auxiliary load. The unit and station transformer sizes will vary in the schemes which have been put forward, but there is one overriding consideration. When the reactor is built extensive tests will have to be carried out prior to the reactor being commissioned and the main sets put on load. This means that very large station transformers must be available for testing, whatever scheme is used.

Unit Scheme

If complete flexibility is considered in the case of unit supply then it must be possible to run a reactor when supplying steam to one set only. With this method it means that as all six circulators must be running, the station transformer must supply the load of four circulator motors while a unit supplies two motors. This must be considered when assessing the station transformer size, but again volt drop considerations may put the size up beyond the power required for the four motors.

The unit transformer size would cover the normal unit load plus two circulator motors. This would put the size at about 17 MVA. The size of station transformer for this scheme is again about 30 MVA and due to the current rating required of their circuit-breakers the preferred voltage would be 11 kV unless the transformer had a double-wound secondary which would enable 6·6 kV to be used. The rupturing capacity of the switchgear would be sufficient to cover a unit and station transformer in parallel and a capacity of 500 MVA would be sufficient.

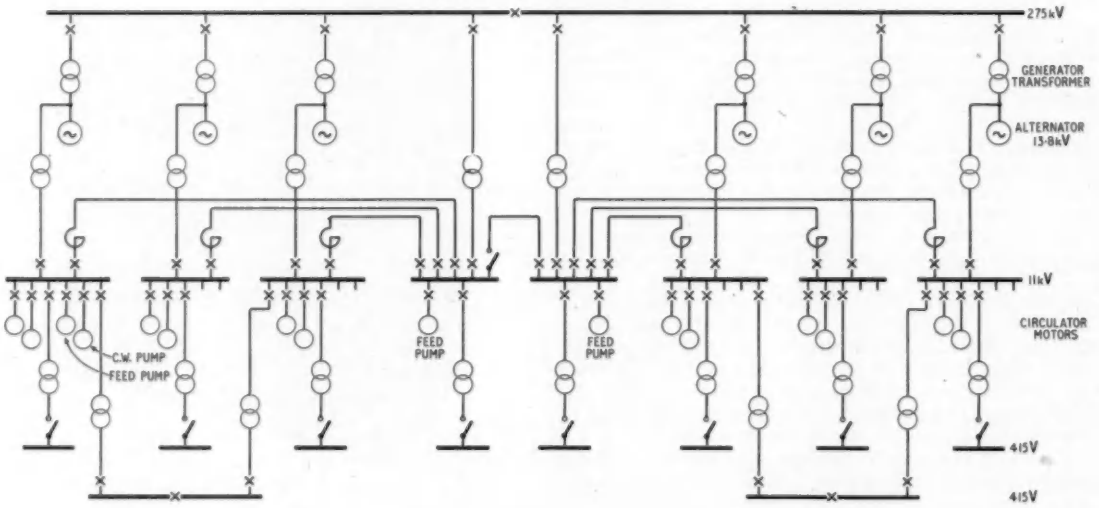
Station Supply

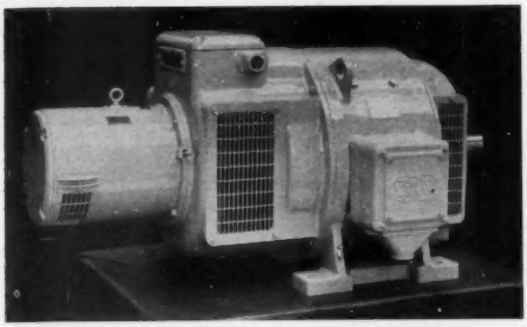
The unit transformer for the station supply method would have to allow for the normal unit load, i.e. 5 MVA, but two station transformers, each of 40 MVA per reactor, would be required. Switchgear having a rupturing capacity of 750 MVA would be necessary, but the current rating is such that 11 kV gear would have to be used and perhaps double windings on the secondary side of the transformers.

Unit/Station Scheme

In the unit/station supply scheme the size of the station transformer would be 30 MVA as in the station scheme and the unit transformer would be 17 MVA as in the unit scheme. As the unit and station transformers are operating in parallel the total transformer capacity is high which means that the rupturing capacity is high. To limit the fault level to 750 MVA, and for other reasons also, current-limiting reactors are included. These have an adverse effect when starting a circulator motor, due to added voltage drop, but if the station transformers are

Fig. 3.—Unit/station board scheme





Example of the latest type of self-regulating alternator with an overhung exciter (Crompton Parkinson)

paralleled when starting the voltage drop is kept within the required limits.

In two-reactor stations it is expected that the first reactor will be operating on load some six months before the second reactor. This means that when the circulator motors of the second reactor require testing there is only one station transformer to supply them. In this case, however, as it is only for a short time it is feasible to disconnect station transformer 1 and connect in parallel station transformer 2 to supply the required load. This means, of course, that the circulator motors on the first reactor are running without any back-up supply for this short period.

The 415 V system for the unit/station sources of supply is the same as for the variable-frequency system, except that the variable-frequency auxiliary boards are not required.

In a nuclear power station the turbine house auxiliaries are the same as for a fossil fuel station. It may be considered necessary, however, to have emergency feed pumps which are required to pump water through the boilers should a total electrical failure occur. This is required as the reactor takes a certain length of time to cool down, and the only method of cooling it is by the CO_2 gas which, in turn, is cooled by the water in the boilers.

Reactor Essential Supplies

The reactor auxiliaries will be the same irrespective of the type of circulator drive and the supply system used. When considering these auxiliaries, their functions and the reactor safety requirements must be known. It is not proposed to go into these in any detail except for those which are important enough to warrant emergency supplies when any possible fault occurs. It must be noted, however, that should a fault occur which would trip the control rods, apart from the loss of power output transient conditions occur in the reactor pile which could have a metallurgical effect on the uranium fuel, i.e. the maximum temperature of the fuel may rise to such an extent that deformation of the metal structure would take place if the control rods did not trip.

The control rods are operated electrically and as these are of prime importance the electrical engineer has to ensure that these cannot lose their supply due to any foreseen fault on the station's electrical system. This means in effect that the reactor electrics must, by and large, have at least two sources of supply and that each of these must be permanently energised. The reactor could, however, shut down due to a total loss of supply and it must be realised that when the reactor shuts down because of a fault heat is being given off for some time afterwards, and it is therefore necessary to have an alternative method of driving the circulators during this period.

The circulator drive consists normally of a driving motor together with an auxiliary " pony " or barring motor. This pony motor is rated sufficiently to circulate enough cooling gas through the reactor during an emergency shut down and a rating large enough to rotate the circulators at 20 per cent of the top speed has been used.

The pony motor can be either d.c. or a.c. operated. If it is d.c. operated a battery supply will be necessary for back-up purposes and as it is assumed that if loss of the main electrical supply occurs it is for an indefinite period, a diesel alternator is required to supply the battery rectifiers. If the pony motors are a.c. operated the diesel alternator supplies would feed them direct, but a point worth noting is that the diesel alternator system must be flexible enough to cover any failure to start of one or more of the sets. In the d.c. system this is covered by providing a battery large enough to run the total load for long enough to enable a standby diesel to be manually started, but for the a.c. system very large flywheels would be needed or some other method used.

Cooling Air Circulation

The heat source of each reactor is contained within a steel pressure vessel and surrounding this vessel is a concrete biological shield. High differential temperatures are not permissible in concrete structures and to guard against the inner face of the shield being subjected to excessive heat it is necessary to circulate cooling air over it. This cooling air must be circulated at all times, i.e., when an emergency shut-down has occurred, and so it is necessary to have an emergency supply on to the fan board. This can be supplied direct from the diesel board. It should be noted that there would be a break in the supply due to the diesel starting time but as this is not long no undue temperature rise is expected.

When charging and discharging fuel elements the gas from the pressure vessel is allowed into the charge machine. It is probable that this gas will have to be circulated constantly and in addition other pumps and grabs must also be available for use at all times. This means that if they are electrically operated, all charge machine auxiliaries must be capable of being fed from an emergency source.

The supply to the reactor instruments is perhaps the most important supply of all as when an emergency shut-down occurs it is then more than ever that instrumentation is needed. The instruments which will be mainly a.c. operated can be conveniently supplied in several ways, one of which uses rectifiers with a battery permanently floating across the output terminals and motor alternators, the a.c. side feeding the instrument board, whilst the d.c. motors are fed from a reliable d.c. source.

With this system there is little danger of losing the source of supply, the instruments are not dependent on the main a.c. supply, the voltage and frequency are not liable to fluctuate and there is no appreciable fault level on the system.

It has been stated above that standby diesel alternators would be required. The number of sets and method of connecting them to the electrical system are varied, but in all cases they must be capable of automatic starting, and if necessary be automatically synchronised and self-loading. There must be sufficient capacity to cover all essential auxiliaries during emergency shut-downs, and in addition enough sets must be installed to cater for the failure to start of one or more (depending on the system used) and for diesel maintenance.

Engineering in Europe

ABSTRACTS FROM FOREIGN TECHNICAL JOURNALS

HEXAGONAL connections of transformers may be defined as being generally arranged like the well-known interconnected-star or zig-zag connections, but with mesh instead of star connection. In this way closed interconnected six-phase arrangements are formed. Symmetrical and asymmetrical hexagonal connections are mostly used in regulating transformers, the latter type particularly in phase-shifting transformers. The vector diagram of these arrangements forms a regular hexagon.

The main groups of these connections may be classified as formed by mesh-interconnection and by double-delta arrangement. The essential features of these types are derived from potential diagrams and the transformation ratios achievable by various combinations set out in tables. A method of evolving new combinations, then applied to the coupling of transformers with different types of connections by means of hexagonal interconnections, is discussed. — "Hexagonal Connection of Transformers," F. Ande, *Osterr. Z. Elekt. Wirtsch.*, Vol. 11, No. 8, pp. 378-382, August, 1958, in German.

Restriking Voltage and Breaking Capacity

Whilst the gas-dynamical conditions of the operation of air-blast breakers were comprehensively investigated and clarified mainly by E. M. Tseirov and his school in the U.S.S.R., other co-determining factors of the breaking capacity were not so thoroughly studied. The authors carried out single-phase tests on air-blast breakers of the same type for 9, 19 and 30 kV to establish the effect of the frequency of the restriking voltage transient on their breaking capacity or, more accurately, on the recovery rate of the dielectric strength in the break.

In logarithmic charts of the experimental results the relation between breaking current and frequency is always represented by straight lines and these lines are parallel for breakers rated for different voltages. The relative position of the main range of restrikings and the curve of the recovery voltage has no effect on the frequency-relation of the breaking capacity. Two main ranges of arc re-ignition were established.—"Effect of the Frequency of the Restriking Voltage Transient on the Breaking Capacity of Air-Blast Breakers," V. Husa and J. Cihelka, *Elektrotech. Obzor.*, Vol. 47, No. 7, pp. 349-354, July, 1958, in Czech.

Earthing of Surge Currents

The layout and calculation of earthing systems, especially extended systems, has to take account of surge conditions, representing a special complication of the calculations. What may be called the "internal surge resistance" of the earthing conductors is a characteristic equally difficult to determine by measurements as by calculation, all the more as the earthing conductors are nowadays, as a rule, iron wires or strips. The consideration of the actual dissipation in the ground is obviously a separate problem, about which much useful work has been done and which can be solved satisfactorily by a combination of experimental and theoretical methods.

The author deals particularly with the phenomena in the extended earth conductors and is able to show that the internal surge resistance of metal conductors is much lower than generally assumed, which is also corroborated by experimental results adduced. After preparatory considerations on surge-current propagation in the electrodes and the ground, the author evolves the field theory of a long strip earth in an infinite ground on the basis of Hertz's theory of oscillating dipoles, using Laplace transforms. It is found that the solutions can be represented by functions available in tabulated form.—"Dissipation of Surge Currents Through Earth Electrodes," W. Bulla, *Osterr. Z. Elekt. Wirtsch.* (OZE), Vol. 11, No. 9, pp. 406-416, September, 1958, in German.

Earthing Through Tower Foundations

The practice of using concrete tower foundations for earthing overhead line towers is mostly based on tests of the resistivity of the material with comparatively low steady currents, which then furnish satisfactory results. As the investigations of the authors show, it would be very risky to rely on figures found in this way in estimating the lightning safety of a line. However, it was not the authors' purpose to determine the surge characteristics of concrete foundations (which, by the way, were determined by British workers and published as an E.R.A. report), but to show by laboratory tests that excessively high current densities in the concrete which may be reached on direct strokes to overhead line towers may actually shatter concrete blocks by spark discharges inside the blocks when the breakdown voltage of the concrete is exceeded. On the other hand, unless this limiting current density is actually exceeded, the mechanical strength of the concrete remains unaffected. The critical value of the current density is 1-1·2 A/cm^2. As would be expected, the moisture content of the concrete has a great influence and the authors recommend that concrete foundations without additional metal conductors should be permissible as tower foot earthing only in regions where the ground remains sufficiently damp throughout the year to keep the earthing resistance low.—"Effects of Surge Currents on the Mechanical Characteristics of the Concrete Tower Foundations," A. V. Korsuntsev and S. D. Merkhalev, *Elekt. Stantsii*, No. 8, pp. 73-76, 1958, in Russian.

Junction-type Rectifier Contacts

Although it was known that an electric impulse (formation) improves the rectifying effect of junction-type germanium and silicon diodes, the nature of the phenomena near the contact could only be surmised, viz. that they may be similar to those in flat diodes, where a surface layer of a conductivity of opposite character to that in the bulk of the material is formed.

The authors established the existence of a region of hole-conductivity near the junction of germanium or silicon diodes—which are n-type conductors—when an electric impulse was applied. The demonstration was carried out by obtaining oscillograms of the thermo-e.m.f. and VA-characteristic before and after the "formation." The effect is quite typical and fully corresponds to the phenomenon in selenium diodes in which a p-n transition had been established previously.—"P-n Transition in Junction-Type Rectifiers." V. G. Mel'nik, I. G. Mel'nik and S. S. Gutin. *Dokl. Akad. Nauk SSSR*, Vol. 121, No. 5, pp. 852-854, 1958, in Russian.

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

Electric Floor Heating Practice

5. Alternative Types of System

By R. D. JACKSON*

This is the final article in the series of five, in which the author discusses the various alternative types of electric floor heating system at present available in this country and specification clauses to ensure that tenders are uniform

A REWIRABLE system comprises elements drawn into tubes or other ducts running between transverse trunkings accommodating connections and to which access can be gained via removable trunking covers. The system layout is usually dictated by the range of elements available since the access trunkings require to be spaced a distance apart which will exhaust the element in a single run or, after making several runs resulting in a serpentine formation with the bends in the trunking. The access trunking is usually placed in the floor at the foot of a wall where it will not be subjected to heavy traffic, or in or on the wall. Installations have been made with the trunking on the ceiling of the room below.

The proposed positions of trunking runs should be marked on the drawings, the distances between being suitable for the elements concerned. In small spaces maximum use of floor surface can be made by using only one trunking if element ducts connecting to the trunking are linked in pairs with semi-circular loops and the elements are drawn up one duct, round the loop and back into the trunking. The distance from trunking to springing line of loops is usually limited to 30ft.

Zoning

If rooms are being zoned and trunking positions have been settled, thus determining element lengths and loadings, the distance from wall to wall of a typical room should be measured. This distance, multiplied by the linear rating of the element, will give the wattage input for one element run across the room. This wattage divided into the required loading will indicate the number of element runs necessary for the zone as a whole.

Outer runs are usually positioned for convenient entry into the access trunking and the distance between these is divided equally to accommodate the remaining runs. Runs are often spaced more closely together near outside walls to maintain an even floor temperature. There would otherwise be a drop of several degrees over the last 2 to 3ft due to edge loss. Care should be taken to ensure that only the length of element within the perimeter of the particular room is included in the assessment of beneficial load. Control can be exercised by means of single thermostats, operating the coil of a relay or contactor carrying the heating load in each zone.

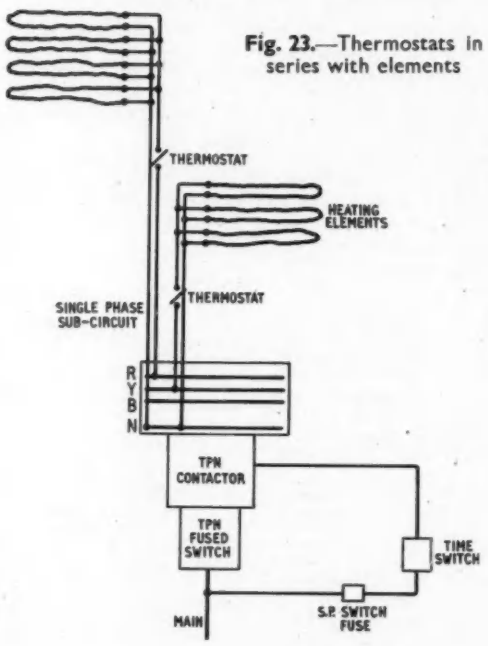


Fig. 23.—Thermostats in series with elements

Individual Treatment

Where individual treatment is to be given the floor trunking is often placed in the corridor and element runs are taken out at right angles to the foot of the far walls of the rooms (Fig. 21). The portion of the element run between the trunking and the corridor wall may be sufficient in the aggregate to heat the corridor. Elements situated under the corridor wall should be ignored as far as any assessment of useful heating load is concerned.

The method of calculating the required number of element runs is similar to that for zoning except that the value of one run is measured from corridor wall of room to centre of loop. Individual thermostatic control is usually provided in each space. There is no reason why similar rooms should not be grouped under central control, except that zoning does this more cheaply.

Directly Embedded System

Systems of this type employ an element suitable for burying solidly in the floor screed. There is no access for replacement purposes. Various elements are available, some have fixed length and loading; others are rated on conductor size and resistance per yard only, leaving the designer to determine his own convenient lengths and loadings within certain limits as to element temperatures.

Directly embedded systems are generally cheaper than withdrawable systems due to their lack of access facilities, and cost is not materially affected by building layout. The general design and application follows the same lines as the rewirable system. Approximate loads for quick assessment purposes can be obtained from Table IX and attention is drawn to the need for supplementary heating in certain locations. If these loadings are used for actual design, both air and floor thermostats are recommended.

Thermostat positions should be selected with reference

* Technical Director, Tyrad Electric, Ltd.

to orientation and wiring costs and normally they can be placed near the point of connection of the heating elements to be controlled. Large numbers of thermostats do not improve control except where different exposures have to be taken into account and relays and contactors can be used with advantage, particularly in large spaces. It should be remembered that thermostats used with off-peak installations constitute only limiting devices in so far as they limit room temperatures to the prescribed level whilst intake is occurring. Readjustment during the day will have no immediate effect.

External controllers are normally fitted only to the larger installations where the extra cost can be expected to be recovered fairly quickly from the saving in consumption. For very large single-storey buildings it may be an advantage to have several external controllers for the purpose of registering differences in exposure. In the case of multi-storey buildings, floors above ground can be expected to have varying exposures and it may be preferable to install an external controller on every floor.

Wiring

Figs. 23, 24 and 25 are typical wiring diagrams, but these require to be backed up with detailed wiring schedules indicating element lengths and ratings, grouping for thermostatic control and allocation of fuseways. With rewirable systems, elements are made to fixed lengths and ratings. Sometimes, standard lengths will be cut back, thereby increasing the rating and linear loading (keeping within the manufacturer's limits), and the installing electrician must be given this information. Table X shows a comprehensive wiring schedule for a rewirable system.

Similar details are necessary if a directly embedded system is to be installed and preparation is simple where standard elements are involved. Greater detail has to be provided where elements are supplied on large reels for cutting to suit requirements on site. Table XI includes ohmic values which require to be checked in the latter case. Checking of individual elements is impossible until they have been cut and it is best to check the entire reel. The individual elements can be cut overlength at first and wastage for this purpose should always be allowed.

TABLE IX

Building Type	Comfort Level	Watts per sq ft	Supplementary Heating Recommended
Houses	60–65	*15	In living rooms
Flats	60–65	*15 Ground floor *13 Interm. floors *15 Top floor	In living rooms
Offices, Laboratories, Schools, Workshops single storey ...	65	13	
two-storey ...	65	12 Ground floor 15 Top floor	In end rooms
multi-storey ...	65	12 Ground floor 10 Interm. floors 15 Top floor	(Note.—All rooms in single-storey buildings and on top floors may require supplementing if roof "U" value is over 0·3)
Churches	55–60	15	In sanctuary, small side chapels and under clerestory windows
Factories	60	13 Up to 12ft high	
	55–60	15 12ft to 15ft high	May be necessary in areas devoted to light work
	Strata heating only	20 Over 15ft high	

* Transmission rate will vary in domestic premises due to the use of different kinds of floor covering. The loads suggested will normally be greater than actual requirements, and should overcome the resistance offered by most floor coverings.

Specification

The majority of electric floor heating systems are installed on the basis of specifications drawn up by the

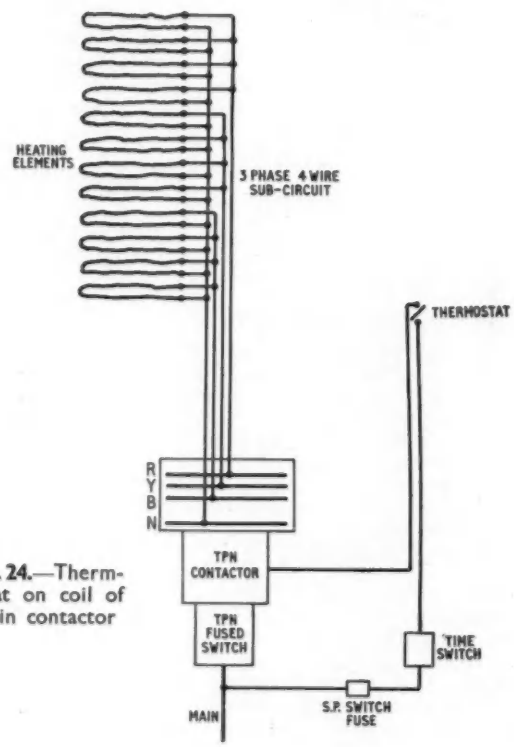


Fig. 24.—Thermostat on coil of main contactor

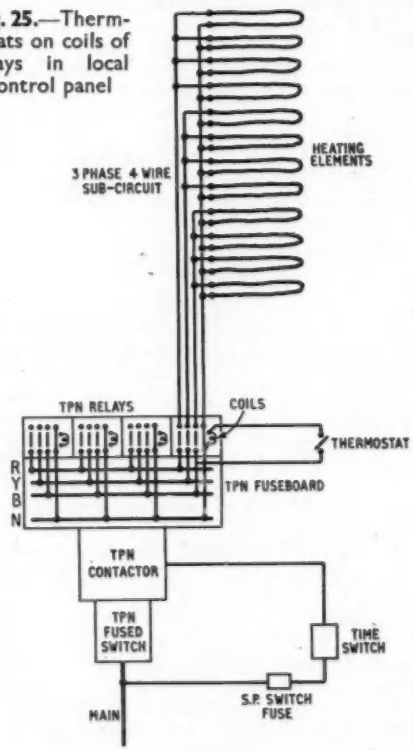


Fig. 25.—Thermostats on coils of relays in local control panel

TABLE X.—HEATING SCHEDULE FOR REWIRABLE SYSTEM

Panel No.	No. of cables	Cable length		Heating load				Controls		Circuit No.		
				Cable load (kW)	Circuit							
		Supplied ft	Installed ft		R	Y	B	Thermostat No.	Relay No.	R	Y	B
1	7	75	75	·75	1·5	1·5	2·25	T1	A1	1	1	1
2	6	90	90	·85	2·55	2·55		T2	A2	2	2	
3	7	65	65	·79	1·46	1·46	2·19	T3	A3	3	3	3
4	16	81	79	·715	2·145	2·145	1·43	T4	A4	4	4	4
				1·43		2·145	2·145		A5	5	5	5
5	5	118	118	1·08		2·16	3·24	T5	A6		6	6
6	14	110	104	1·165	2·33	2·33	3·495	T6	A7	7	7	7
					2·33	2·33	3·495		A8	8	8	8
7	7	55	55	·625	2·5		1·875	T7	A9	9		9
8	8	75	75	·75	3·0	3·0		T8	B1	1	1	
9	6	90	88	·87	2·51	2·51		T9	B2	2	2	
10	15	90	87	·88		2·64	2·64	T10	B3		3	3
					2·64	2·64	2·64		B4	4	4	4
11	6	118	118	1·04	2·08	2·08	2·08	T11	B5	5	5	5
12	14	110	104	1·165	2·33	2·33	2·33	T12	B6	6	6	6
						2·33	2·33		B7		7	7
					2·33		2·33		B8	8		8
13	3	90	82	·935			2·805	T13	—			1
	1	75	75	·75			·75	T14	—			2
14	8	75	75	·75	3·0	3·0		T15	C1	1	1	
15	6	90	88	·87	2·51	2·51		T16	C2	2	2	
16	15	90	87	·88		2·64	2·64	T17	C3		3	3
					2·64	2·64	2·64		C4	4	4	4
17	6	118	118	1·08	2·08	2·08	2·08	T18	C5	5	5	5
18	14	110	104	1·165	2·33	2·33	2·33	T19	C6	6	6	6
						2·33	2·33		C7		7	7
					2·33		2·33		C8	8		8
19	3	90	82	·935			2·805	T20	—			1
	1	75	75	·75			·75	T21	—			2
20	10	75	75	·75	3·0	2·25	2·25	T22	D1	1	1	1
21	8	90	88	·87	3·48	3·48		T23	D2	2	2	
22	19	90	87	·88	3·52	2·64	2·64	T24	D3	3	3	3
					2·64	2·64	2·64		D4	4	4	4
23	8	118	118	1·08	3·24	2·16	2·16	T25	D5	5	5	5
24	18	110	104	1·165	2·33	2·33	2·33	T26	D6	6	6	6
					2·33	2·33	2·33		D7	7	7	7
					2·33	2·33	2·33		D8	8	8	8
25	4	90	82	·935			1·87	T27	—			2
							1·87	T28	—			9

TABLE XI.—TYPICAL HEATING SCHEDULE FOR EMBEDDED SYSTEM

Panel No.	No. of elements	Length in ft	Load kW per element	Core		Ohms value per element	Circuit			kW circuit load			Thermostat No.	Relay No.
				Reference	Size		R	Y	B	R	Y	B		
1	2	200	1·0	ES100	032	57·7	1	—	—	2	—	—	1	—
2	3	150	0·75	ES75	024	77·0	—	1	—	—	2·25	—	2	—
3	1	400	2·0	ES218	032	28·9	—	—	1	—	—	2	3	—
4	9	200	1·0	ES100	032	57·7	2	2	2	3	3	3	4	1
5	6	300	1·5	ES163	024	38·4	3	3	3	3	3	3		2
	6	300	1·5	ES163	024	38·4	4	4	4	3	3	3	5	3
	6	300	1·5	ES163	024	38·4	5	5	5	3	3	3		4
6	1	600	3·0	ES326	048	19·2	6	—	—	3	—	—	6	—
	1	600	3·0	ES326	048	19·2	7	—	—	3	—	—	7	—

manufacturers or contractor and the client is rarely fully aware of the duty the system is designed to perform or the manner of performance. In some cases where several tenders for floor heating have been invited the client is faced with deciding between several entirely different solutions to the same problem with different heating loads and annual electricity consumption. The following clauses can be used for tendering purposes as may be applicable to individual buildings and should ensure all relevant factors being taken into consideration and all tenders being on the same basis.

1. *COMFORT EFFECT*
The floor heating system is to be designed to maintain internal ..... deg F against outside ..... deg F with normal natural ventilation throughout.

2. *"U" VALUES*
The following "U" values are to be used in calculations.
External walls .....
Partition walls .....
Window glass .....
Roof glass .....
Roof Flat .....
Pitched .....

3. *SCOPE*
The areas to be heated are indicated on Drawings Nos.....

4. *EFFICIENCY*
The following allowances should be made in calculations in respect of heat lost non-beneficially to the rooms concerned.
Ground floors .....per cent
Top floors .....per cent
Overhanging floors .....per cent

5. *MARGIN*
A working margin of ..... per cent should be added to all final calculated loads.

6. *INTAKE HOURS*

7. *ELECTRICITY SUPPLY*

8. *FLOOR SURFACE LIMITS*
The system is to be designed with floor surface temperatures limited to
Rooms generally occupied 75 deg F
Rooms intermittently occupied 80 deg F
Entrance halls, corridors, etc. 85 deg F
subject to the suitability of floor finishes as shown on the drawings or as scheduled hereunder.

9. *HEATING LOAD*
Floor heating .....
Supplementary .....
Total .....kW

10. *SUPPLEMENTARY HEATING*
Type, general disposition and supply requirements to be indicated.

11. *ELECTRICITY CONSUMPTION*
The electricity consumption to be expected for an average heating season of ..... days' duration is
Floor heating .....
Supplementary .....

New Books

Solution of Problems in Electrical Technology. By H. Cotton and J. V. Parry. Pp. 315; figs. Sir Isaac Pitman & Sons, Ltd., Pitman House, Kingsway, London, W.C.2. Price 20s.

This book consists almost entirely of solutions to a very wide range of problems dealing with the principles of electromagnetism, electrostatics, d.c. and a.c. circuits and machines, electronics and illumination, the standard being roughly that of the first year of a university course and up to the A1 course for a Higher National Certificate in electrical engineering.

Each chapter starts with a summary of the relationships relevant to that chapter and some of the problems are concerned with the derivation of important formulæ; but most of the problems illustrate the procedure to be followed in solving numerical questions. The text is extremely well drafted and should prove a most useful guide to students desiring to learn how answers should be set out in a readable and easily comprehended manner. Each chapter concludes with a few problems for the reader to work out independently, but it is felt that this aspect of the book could be expanded with advantage. The text is very free of typographical errors and the diagrams are clearly reproduced. The authors might reconsider the arrangement of Fig. 10.7, which gives the impression that the current in an inductive circuit leads the applied voltage. The minus sign in the solution for Q.11, p. 25, and the answer to the final part of that question are incorrect—the solution ignores the fact that the capacitor will be across the supply before the circuit is broken. It is to be deprecated that the authors should use the terms "magnetising intensity" and "electric field intensity" instead of the terms recommended by the British Standards Institution.

In spite of these and other minor blemishes, this volume can be whole-heartedly recommended to students studying electrical technology, and the price is reasonable.—E.H.

Principles of Noise. By J. J. Freeman. Pp. 299; figs. John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 74s.

The author, in his preface, states that "engineering maturity rather than specific course work is the prerequisite" for the course in which this book originated, and that it aims to acquaint the student with enough of the principles, facts and techniques used in noise analysis to take him to the level where he can read the literature with enough ease to use it as a professional tool. The treatment is uncompromisingly mathematical, and it is therefore appropriate that both the opening chapters and a subsequent one are of purely mathematical content. The opening chapter is devoted to Fourier series and integrals, and the second to probability theory. The third chapter deals with stationary random processes and the fourth with physical sources of noise. In these chapters such topics as the autocovariance function, temperature-limited diode, and shot current through an impedance, are covered, and Nyquist's law, noise in resistors, diodes and multi-electrode structures, and the measurement of noise power are discussed. Succeeding chapters deal with equivalent noise generators, including two- and four-terminal networks, noise factor, including the cathode follower, grounded grid and cascade circuits, and the measurement of direct voltage, including the minimum detectable signal and time averaging. The last three chapters constitute the third purely mathematical section. They deal with the Gaussian random process; the detection of a.c. waveforms, and a discussion of target noise in radar tracking, a subject on which the author has served as a consultant to the U.S. Naval Research Laboratory. Numerous problems and examples are scattered throughout the text, and there are large numbers of text figures.—P.L.D.

Fourth National Symposium on Vacuum Technology Transactions. Edited by W. G. Matheson. Pp. 176. Pergamon Press, 4 and 5, Fitzroy Square, London, W.1. Price 90s.

The American Vacuum Society, Inc., and its predecessor organisation, the Committee on Vacuum Techniques, Inc., have organised a series of annual symposia on vacuum technology, and the volume under review is the record of the fourth of these, which was held in October, 1957. A total of 28 papers was presented, and these were grouped under three general headings: the scientific basis of vacuum techniques and their application to scientific and applied research; methods and technique for obtaining and measuring high vacuum; and industrial applications. In the first category were placed papers on the use of a Roots blower in conjunction with a mechanical vacuum pump, on oil diffusion pumps for very low ultimate pressures, with an assessment of some pump fluids, and on the use of liquid metal seals for high vacuum. In a lengthy paper, the evaporation modes of a number of typical sources are described, as investigated by a technique of labelling the charge with a trace of a radioactive isotope, while other papers on various aspects of the evaporated metal films included a consideration of the anomalous resistance-temperature characteristic of evaporated chromium.

Papers on pumping covered design criteria for accelerator vacuum systems, and distributed differential pumping for an experiment on plasma beams. Large-scale industrial process pumping at rates up to 100,000 cu ft/min or 5 lb/hr at 0·01 mm pressure and 1,000 lb/hr at 10 mm pressure is made possible by the steam ejector pump, which is also capable of handling "dirty" processes without especial difficulty. Such processes include vacuum melting of metals and alloys by either arc or induction heating, whilst other similar processes considered include vacuum heat treatment, and the removal of gaseous impurities from already highly purified metal by vacuum re-melting. The vacuum drying and impregnation of paper insulation for cables, transformers, etc., was discussed in another paper. Other subjects included the production of very low pressures by continuous "gettering," the analysis of the residual gases in sealed-off tubes, a new silicone diffusion pump fluid, the addition of a magnetic amplifier to the conventional Pirani gauge circuit, and a type of halogen leak detector.—P.L.D.

BOOKS RECEIVED

Metal Rectifier Engineering. By E. A. Richards. Pp. 209; figs. Sir Isaac Pitman & Sons, Ltd., Pitman House, Kingsway, London, W.C.2. Price 37s 6d.

Diesel Plant Operators' Handbook. By A. K. L. McCrone. Pp. 215; figs. Sir Isaac Pitman & Sons, Ltd., London. Price 20s.

VIEWS on the NEWS

By REFLECTOR

THE *Electrical Age* for January contains a forecast by the director, Miss Mary George, of the 1959 activities of the Electrical Association for Women. She says that there will be a concentration on the Association's wiring campaign during the year and she points to the need for the inspection and testing of domestic installations. She goes on to say:—

"Many people are, of course, afraid of having their wiring system overhauled because they know in their heart of hearts that complete rewiring is needed, and that this is not a cheap job. Perhaps the easier credit facilities now available may encourage some electrical contractors to follow what is fairly common practice in the United States and offer credit terms for major wiring work."

Miss George does not suggest that the Electricity Boards should provide this service, although before nationalisation "assisted" wiring by electricity supply undertakings was common. I feel that contractors generally would not find it easy to finance such schemes; they are already chary of entering the appliance hire-purchase business, which is really a simpler matter—but still difficult.

* * *

Another reader has written to me on the subject of 13 A socket-outlets. He takes me to task for "dismissing" the danger of young children being able to touch the partially withdrawn pins of the plug and says that "any parent will testify to the consuming interest of small children in 'forbidden' electrical appliances and impedimenta," adding that I must be sufficiently detached from child care duties not to know how children can court danger in many forms 10 seconds after the last precautionary parental peep. It was precisely because these hazards do exist that I questioned whether a baby under a year old could be left without supervision even if there were no risk from the plug and socket. I certainly had no intention of "dismissing" this particular hazard, to which attention was drawn in a note in these columns early last year, and I hope that others who have views on the matter will write to me. My correspondent says he has found that two layers of "Sellotape" give effective, though not very permanent, protection and suggests that insulated sleeves should be fitted to the pins.

* * *

Reporting a meeting of the Hornchurch (Essex) Council, the *Romford Recorder* says that a scheme for installing gas water heating in 500 Council houses, at a cost of £38,045, was adopted. This decision was taken in spite of the fact that electric water heaters would have cost only £25,500, the excuse being that as the houses concerned were old "there might well be hidden costs in the installation of electric systems." If this means that the wiring is not all it ought to be the matter should surely be attended to. An objectionable feature of the debate was the Council's refusal to adopt a suggestion that the tenants should be allowed to choose their own system. One councillor said that it was "more convenient to install gas at the moment."

* * *

As is natural, and to some extent understandable, the National Parks Commission is perturbed by the erection of nuclear power stations in the areas under its care. Generally its objections are straightforward, but in a reference to the proposed Edern (Caernarvonshire) station in its latest annual report it indulges in the following circumlocution:—

"We do not see how we shall be able to do otherwise than advise that such development could not fail to be prejudicial to the natural beauty of the area."

* * *

New municipal flats in Birmingham have electric floor warming and the Midlands Electricity Board and the Birmingham Corporation are co-operating to advise tenants how to secure the best and most economical operation. So far, says the *Birmingham Mail*, there have been no complaints. Occupants of the middle floors seem to be particularly pleased for they say that their flats receive enough heat from their upper and lower neighbours to make it unnecessary to use their own installations.

* * *

A threnody on the Glasgow trams appears in *Colville's Magazine*. The remainder of these vehicles are to disappear within the next five years after the system has been in operation for about sixty years. Now the rails are being taken up and fed into Colville's furnaces as scrap. The Glasgow tramways were noted for their low fares. At one time there was a maximum of 2d and for this it was possible to go from Milngavie to Renfrew Ferry, a distance of nearly 23 miles.

* * *

Upon referring to the *Electrical Review* of 13th January, 1899, I find a report of a discussion at a Glasgow Town Council meeting on the system to be adopted for the conversion of the horse tramways to electrical operation. Several reasons were adduced for not employing the conduit system and it was finally decided to install overhead trolley wires. It was pointed out that

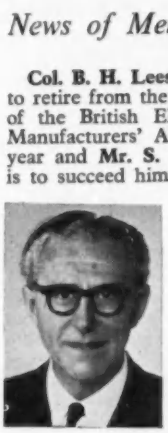
"If the overhead system were adopted generally, and if in the future some system of electric traction which dispenses with overhead wires were found to be practicable for the Glasgow tramways, the removal of these wires would not involve any considerable loss, as the permanent way, feeders and rolling stock would be equally suitable for any system of electric traction."

This was a bad guess as the only other feasible electric street traction system to evolve was the trolley-bus which needed overhead wires but dispensed with the rails.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Col. B. H. Leeson, C.B.E., T.D., is to retire from the position of director of the British Electrical and Allied Manufacturers' Association later this year and **Mr. S. F. Steward,** C.B.E., is to succeed him. Mr. Steward has



Col. B. H. Leeson

Mr. S. F. Steward

been appointed director-designate as from 1st February. On 31st January he is relinquishing his positions as group managing director of Lancashire Dynamo Holdings, Ltd., and chairman of Lancashire Dynamo & Crypto, Ltd., Lancashire Dynamo Electronic Products, Ltd., and Lancashire Dynamo Group Sales, Ltd.

Col. Leeson has been director of B.E.A.M.A. since 1946 when he succeeded Mr. V. Watlington. He began his career with Siemens Bros. Dynamo Works and after service with the Divisional Engineers, R.N.D., in the 1914-18 war he joined A. Reyrolle & Co., Ltd., for whom he formed a technical and research department. He was closely associated with the establishment of the first British short-circuit testing station and with the standardisation of switchgear performance. He helped to form the Association of Short-circuit Testing Authorities (ASTA) and he became a director of the British Short-circuit Testing Station, Ltd.

Col. Leeson was appointed joint manager of Reyrolles in 1937 and a director in the following year. He was a Territorial and commanded the Tyne Electrical Engineers, R.E. When war was declared in 1939 he was "embodied" but in 1940 he was released to become general manager of Reyrolles; he was appointed managing director in 1945.

He has a long record of service to the Institution of Electrical Engineers. He was chairman of the North Eastern Centre in 1930, vice-president of the Institution from 1948 to 1951 and President in 1952-53.

Mr. Steward was for many years associated with Bull Motors (E. R. & F. Turner, Ltd.) and was on the board of the latter company. During the last war he served in the Ministry of Supply as director of industrial electrical equipment and, later, as director-general of machine tools. Upon the nationalisation of the electricity supply industry Mr. Steward was appointed chairman of the South Western Electricity Board but he resigned that position in 1955 to become managing director of Lancashire Dynamo Holdings, Ltd. Later he became chairman of the three companies of the group mentioned in the opening paragraph. He succeeded Sir Percy (now Lord) Mills as chairman of the group in 1957 but relinquished that appointment last year, while continuing as managing director.

Lancashire Dynamo Holdings, Ltd., announces the appointment of **Mr. D. C. Lorkin,** F.C.I.S., previously joint managing director with Mr. S. F. Steward, as the managing director of the company. This appointment is consequent upon Mr. Steward's resignation of the position of joint managing director of the company and his appointment as director-designate of B.E.A.M.A. Mr. Lorkin joined Lancashire Dynamo & Crypto, Ltd., in 1932, became a director in 1946 and managing director of L.D.C. in 1951, a position he still retains.

Mr. D. C. Lorkin

Consequent upon his recent appointment as chairman of the A.E.I. Divisional Management Co., Ltd., and divisional director and general manager of the A.E.I. Heavy Plant Division, **Mr. L. Drucquer** has relinquished his appointment on the board of the B.T.H. Co.

Mr. K. R. Hopkirk, director and chief mechanical engineer of the B.T.H. Co., retired on 31st December after forty-three years with the company. He joined the B.T.H. Test Department at Rugby in August, 1915. Four years later he was placed in charge of the turbine test and at the end of 1920 joined the design staff of the Turbo-Generator Engineering Department, becoming chief in 1939. In 1945 Mr. Hopkirk was appointed assistant chief mechanical engineer of the company and in 1949 became chief mechanical engineer. Later in the same year he was elected to the board of directors. Mr. Hopkirk has been closely identified with the development of turbo-alternators up to the largest sizes during the past thirty years, especially with the design of 33 kV windings and the associated problems of surge protection. He was responsible for the design of the largest 3,000 r.p.m. air-cooled alternators at present operating in this country and rated at 75 MVA, 0·67 p.f., 33 kV.

Mr. H. S. Holbrook, B.Sc., M.I.E.E., Fel.A.I.E.E., consulting engineer to the company on transformers, Rugby, has retired after 48 years' service.

Mr. Holbrook joined the B.T.H. Co. in 1910 and has been engaged on the design of transformers since 1911. He was appointed chief transformer engineer in 1929, and since that date he has been actively engaged with the development of many new transformer constructions. He has travelled widely and has served on B.S.I., E.R.A., B.E.A.M.A. and other committees. He relinquished the managership of the B.T.H. Transformer Engineering Department in 1950 when he was appointed consulting engineer on transformers.

After nearly forty-four years' service with the B.T.H. Co., **Mr. H. Dreghorn,** B.Sc., F.I.W.M., manager—manufacturing, Rugby Works and sub-factories, has retired. At a gathering of colleagues and friends, a presentation was recently made to him by Mr. H. E. Cox, director and general manager, Rugby Works.

Mr. Dreghorn joined the B.T.H. Co. in 1915 at Rugby as a test engineer and later spent eight years on the engineering design of a.c. commutator motors. In 1928 he was transferred to the manufacturing side, being appointed superintendent of the motor factory at Rugby. He was also respon-

Mr. K. R. Hopkirk

Mr. H. S. Holbrook

Mr. H. Dreghorn

Mr. S. A. Couling

sible for the production of instrument and distribution transformers. Four years later, when the company commenced the manufacture of domestic appliances, he was appointed superintendent of the home appliance factory. During the last war he was planning engineer, being responsible for planning the production of armaments manufactured at Rugby Works and at the Blackbird Road factory, Leicester. In 1949 he was appointed general superintendent and in 1957 manager—manufacturing, Rugby Works and its sub-factories. Early in the year he plans to make an extended trip to Australia and on his return to England towards the end of 1959 will reside in Sussex.

Mr. S. A. Couling, M.I.Mech.E., A.M.I.C.E., of the B.T.H. Chief Engineer's Department and formerly chief gear engineer, has retired after thirty-three years' service with the company.

Mr. Couling joined the B.T.H. Turbine Engineering Department in 1925 and one of his outstanding achievements was the design of the 3,000-s.h.p., 5,050/200 r.p.m. geared turbine propeller drives with locked-train double-reduction gearing, for Admiralty frigates. He was appointed chief gear engineer about ten years ago.

Mr. R. Craig Wood has been elected a director of Associated Electrical Industries, Ltd. He has been managing director of A.E.I.-Hotpoint, Ltd., since 1956 and in this capacity he will continue to have responsibility for the domestic appliance business of A.E.I. He is also chairman of A.E.I.-Gala, Ltd., which handles the export of domestic appliances. Mr. Craig Wood graduated B.Sc. from Glasgow University in 1933 with first-class honours. His earlier business career was mostly with Thomas Hedley & Co., Ltd., of which firm he was managing director for a number of years.

Mr. R. Craig Wood

British Insulated Callender's Cables, Ltd., announces the appointment of **Mr. G. N. Blades,** A.M.E.M.E., as regional manager, London, in succession to **Mr. E. A. Sayers,** who retired on 31st December. Mr. Blades was formerly divisional sales manager (rubber cables) at the Leigh Works and this position has been taken by **Mr. D. I. S. Hinton,** B.A. (Mech. Science), who was previously sales engineer (aircraft).

Mr. Sayers was educated at Alleyn's School and served his apprenticeship between 1911 and 1914 with the London and North Western Railway Co. at Crewe. During the 1914-18 war he served with the R.E. Signals. He joined the London sales organisation of British Insulated & Helsby Cables in 1923, and in 1944 was appointed manager of its Manchester branch. After the formation of B.I.C.C. he became, in 1948, assistant sales manager (power cables) and has been regional manager, London, since 1953.

Mr. G. N. Blades

Mr. E. A. Sayers

Mr. D. I. S. Hinton

Mr. Blades was educated at Felsted and Nottingham University, and continued his training between 1940 and 1942 as a mining student with the Butterley Co., Ltd. He served with R.A.F. Coastal Command during the last war until 1946, when he joined B.I.C.C. His first position was mining sales engineer in Edinburgh until 1950, and later in Nottingham, until 1955. He then became assistant sales engineer (mining) for two years before being appointed divisional sales manager (rubber cables) at Leigh Works.

Mr. Hinton was educated at Merchant Taylors' School and subsequently at Emmanuel College, Cambridge, where he graduated B.A. in mechanical sciences. He served a one-year apprenticeship with Vickers-Armstrongs before joining B.I.C.C. in 1954 as sales engineer (aircraft).

Mr. R. Melton, manager of the A.E.I. Melton Road Lamp Works, Leicester, retired at the end of December. He was formerly with the B.T.H. Co. and for his war-time work at Rugby, where he was in charge of the production of electronic devices used in radar, he was awarded the B.E.M. More than a decade earlier he was one of the pioneers in the production of the photo-electric cell. His career with B.T.H. began shortly after the 1914-18 war. He went to Leicester shortly after V.E. Day, as production superintendent of the new lamp works taken over by the B.T.H. Co. from the Government. From 1949 he was in charge at Melton Road, first as works superintendent and, since January, 1956, as manager. He is a Fellow of the Institution of Works Managers and a former chairman of the Leicester Branch of the Institution.

He is succeeded by **Mr. K. O. Smith,** formerly production superintendent of the Leicester Lamp Works. Mr. Smith joined the Melton Road factory in 1940 when it was being operated by B.T.H. on behalf of the Ministry of Aircraft Production. During the war years he was head of the Production Planning Department. He transferred to lamp manufacturing in 1946 and in 1947 was appointed assistant production superintendent. He has been deputy manager of the Lamp Works since June, 1958.

Mr. R. Melton

Mr. K. O. Smith

Mr. W. Newland, previously personal assistant to Mr. J. Ayres (managing director) and also associate director in charge of export, has been appointed commercial director of Simms Motor Units, Ltd. In his new capacity he assumes overall responsibility for the sales division in its entirety, including the branches organisation, and also the export and service divisions.

Mr. W. Newland

Mr. H. G. Dunn

Mr. H. G. Dunn, M.I.Mech.E., M.S.A.E., has also joined the board. He joined the company in 1934, was appointed fuel injection engineer in 1938, became assistant chief engineer in 1953 and chief engineer in the following September, relinquishing that position upon being appointed an associate director on 1st January last year.

The British Central Electrical Co., Ltd., held its annual Christmas party on 20th December at the Criterion Restaurant, Piccadilly, W.1, when over sixty members of the staff sat down to dinner. The health of the company was proposed by Mr. J. F. Cowlin, western area manager, and Mr. C. Gordon Marks, company secretary and general manager, replied. Mr. G. Conradi, A.M.I.E.E., managing director, thanked the staff for their services during the year and spoke briefly of the company's early history. Bouquets were presented by the staff to Mrs. F. J. Conradi, and to Mrs. Gordon Conradi, and during the evening the chairman

cut the golden jubilee cake. An excellent cabaret was provided and afterwards there was dancing and games.

Mr. T. Nethersole, sales manager at the Ferrybridge office of the Philidas locknut division of Whitehouse Industries, Ltd., has taken over the company's sales organisation throughout London, Middlesex, Surrey, Kent and Sussex. He is at the London office of the company, 44, Hertford Street, W.1 (telephone: Legation 3888).

Mr. C. Dotson, of Dallas, Texas, U.S.A., has been appointed chairman of the board of Texas Instruments, Ltd., Bedford. Mr. Dotson succeeds Mr. P. E. Haggerty, president of Texas Instruments, Incorporated, as chairman of the British company. A new plant is planned for erection on a site of 240,000 sq ft at Hoo Farm, Bedford. Building will commence early this year and by 1963 it is expected that 1,400 people will be employed.

Mr. C. Dotson

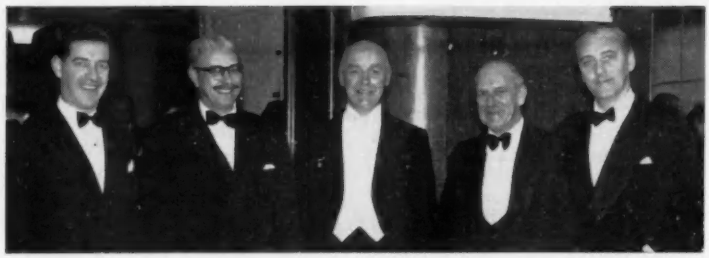
Mr. R. R. Kenderdine, M.I.Prod.E., has been elected a director of Crompton Parkinson, Ltd., with effect from 1st January and he has been appointed a managing director.

Mr. R. R. Kenderdine

The annual dinner-smoker of the **Electrical Trades' Commercial Travellers' Association** was held recently at the Windsor Castle, Victoria, London, when 200 members and their guests sat down, and afterwards were entertained by members of the "Dare Male Choir," Aberdare, Glamorgan, who were introduced by Mr. D. Morris, branch chairman, South Wales. A general meeting of the Association is being held today (Friday) at 6 p.m. at the Feathers Hotel, Broadway, Westminster, London, S.W.1.

Mr. D. Latham has been appointed to the Birmingham office of Brook Motors, Ltd., as a sales engineer. A former Brook apprentice, having ten years' service with the company, Mr. Latham was previously employed in the Production Planning Department at the Huddersfield Works.

The annual dinner and dance of the West London Branch of the **Association of Supervising Electrical Engineers** was held on 3rd January at Derry & Toms Restaurant, Kensington. Among the guests welcomed by Mr. R. F. H. Twentyman (branch chairman) and Mrs. Twentyman were Mr. and Mrs. C. T. Melling and Mr. and Mrs. E. A. Bromfield. The national chairman, Mr. J. H. K. Pendry, proposed the toast of the ladies, to which Mrs. W. F. Parker replied. Mr. C. T. Melling, in proposing the toast of the West London Branch, mentioned its fine record and referred to it as the "cradle of national chairmen."



At the A.S.E.E. West London Branch dinner (left to right): Mr. N. H. O'Hara (branch secretary), Mr. R. F. H. Twentyman (branch chairman), Mr. C. T. Melling, Mr. J. H. K. Pendry (national chairman) and Mr. E. A. Bromfield (general secretary)

The Ministry of Power has announced the retirement of **Sir Cecil Oakes** from membership of the Eastern Electricity Board at 31st December last and following the last meeting of the Board Sir Cecil received a smoker's cabinet as a personal gift from his colleagues. In the course of the meeting of the Board, the chairman, Mr. H. V. Pugh, paid tribute to the valuable contribution Sir Cecil, as one of the founder members, had made to the Board's development during his eleven years of service.

Colonel J. R. H. Robertson, O.B.E., has been appointed an inspecting officer of railways in the Ministry of Transport and Civil Aviation.

Mr. A. S. Marshall has been appointed to the new post of deputy secretary to Mr. H. E. F. Taylor, secretary of the Electronic Engineering Association, 11, Green Street, W.1.

Acheson Industries (Europe), Ltd., announces that **Mr. C. R. Wills,** B.Sc.(Eng.), has been appointed general manager of Acheson Colloids, Ltd., Plymouth.

Mr. G. T. Garwood, M.Sc., M.I.C.E., M.I.E.E., adviser to the Devon Group of Districts of the South Western Electricity Board, and **Mr. C. J. Hocking,** M.I.E.E., adviser to the Board's Cornwall Group of Districts, retired on 31st December.

Mr. G. T. Garwood

Mr. C. J. Hocking

Mr. W. F. Randall, managing director of the metals group of the Telegraph Construction & Maintenance Co., Ltd., left London by air on 3rd January for a visit to the United States in connection with Telcon's metals interests. He is expected to be in America for about three weeks.

Edgar Allen & Co., Ltd., announce the appointment in their subsidiary company, the British "Rema" Manufacturing Co., Ltd., Sheffield, of **Mr. J. P. Lewis** as general manager. He was formerly sales manager of the parent company's Engineering Department. **Mr. T. R. H. Wadsworth** has been appointed assistant general manager of British "Rema." He was formerly chief draughtsman of the combined drawing offices of both the parent company and British "Rema."

Mr. R. E. Sherwood, A.Met., has been appointed manager of the Steel Department of Edgar Allen & Co., Ltd., in succession to **Mr. F. M. Darlow,** who recently retired. Mr. Sherwood joined the Magnet Department in 1938, and after holding various positions, became assistant manager of the Steel Department in 1952.

Mr. K. D. Morgan has joined the staff of Head Wrightson & Co., Ltd., as a sales representative for iron and steel castings and forgings. He will be based at the London office, 20, Buckingham Gate, S.W.1.

Mr. C. N. Jennings, superintendent of the foundry and pattern shop of Ransomes & Rapier, Ltd., retired on 31st December after fifty-five years' service with the company and he has been presented with a portable radio and electric fire and a handbag for Mrs. Jennings by employees. The presentation was made recently by Mr. N. F. Dare, works director.

Mr. H. M. Drake, chairman and managing director of Drake & Gorham, Ltd., sailed on 1st January for South Africa to examine the possibilities that exist in South, Central and East Africa for the electrical contracting and switchgear group that he heads. A programme of dis-

cussions with government officials, civil engineering contractors and other interested parties has been arranged, and Mr. Drake will be joined later in the month by one of his co-directors, **Mr. H. Jones.** While Mr. Drake is in South Africa, two other directors of companies in the group, **Mr. W. B. M. Drake** and **Mr. E. H. Miles,** will be visiting Pakistan and India to discuss licensing and manufacturing agreements with leading electrical companies.

Mr. W. McL. Wishart, divisional accountant of the Yorkshire Division of the Central Electricity Generating Board, has been appointed regional accountant of the North Eastern and Yorkshire Region. He was apprenticed to Davies, Lochhead & Co., chartered accountants, Glasgow, and qualified as a chartered accountant in 1930. In 1931 he was appointed managing clerk with the company and from 1932 to 1941 was assistant accountant, Central Electricity Board, South East and East England Areas. He then became district accountant, Central Electricity Board, Mid-East England Area, and from 1944 of the North East England Area also. He held this post until 1948, when he took up the appointment as divisional accountant of the Yorkshire Division.

Mr. W. McL. Wishart

It was announced in November that the Secretary of State for Scotland had reappointed **Mr. Thomas Johnston,** C.H., LL.D., to serve as chairman of the North of Scotland Hydro-Electric Board for a further period until 31st December, 1958. Mr. Johnston has now agreed to continue to serve as chairman for a further six months to 30th June next. The Secretary of State has also reappointed **Sir John Erskine,** C.B.E., D.L., J.P., to be a part-time member of the Board until 31st December next and **Provost Macrae,** C.B.E., and **Mr. A. I. Duncan Millar,** M.C., M.A., A.M.I.C.E., J.P., to be part-time members of the Board until 31st December, 1961.

Mr. F. C. Perry, chief mechanical designer (rotating machines), Crompton Parkinson (Chelmsford), Ltd., retired on 31st December after almost continuous service from 1911, when he first joined Crompton & Co., Ltd., as an apprentice. Following service with the Royal Engineers during the 1914-18 war he rejoined the company but after a short period went to Rugby as a senior draughtsman with the B.T.H. Co. He returned to Chelmsford in Crompton's machine drawing office where he held successive appointments as senior draughtsman, section leader and, for the last twelve years, chief mechanical designer.

Mr. J. W. Kelham, the new chief mechanical designer (rotating machines), has been with Crompton Parkinson (Chelmsford), Ltd., since 1954 when he took charge of the development drawing office in London. He served his apprenticeship with the Brush Electrical Engineering Co. and at one time was employed by the English Electric Co. at Bradford.

At the annual general meeting of the Domestic Electric Water Heater Section of B.E.A.M.A., held in December, **Mr. K. Taylor,** director of Santon, Ltd., was reappointed as chairman for the ensuing year, and **Mr. G. Housden,** sales manager, Water Heating Department, Simplex Electric Co., Ltd., was reappointed vice-chairman.

Mr. H. C. Timewell, manager of the domestic appliance division of the English Electric Co., Ltd., was appointed chairman for the ensuing year at the annual general meeting of the Associated Manufacturers of Domestic Electric Cookers, held in December. The new vice-chairman is **Mr. A. S. Oldhams,** director and product sales manager of the electrical division of Radiation, Ltd. Mr. Timewell has also been elected chairman of the Domestic Electric Cooker Section of B.E.A.M.A., and Mr. Oldham has been elected vice-chairman.

Transformers (Watford), Ltd., at its annual Christmas party this year also celebrated its twenty-first anniversary. The company was founded in 1937 as Transformers & Welders and changed its name to its present title in 1952. To mark the occasion Mr. G. B. Proctor, managing director, was presented with a large silver key by the youngest member of the company, Miss Westwood, who is fifteen. Mr. Proctor mentioned that an all-time record output had been achieved during the year. He then autographed the key and asked everyone present to do the same as a memento of the occasion.

Sir Edward Crowe, K.C.M.G., and **Mr. A. W. C. McArthur,** M.I.E.E., F.I.W.M., have resigned from the board of W. T. Henley's Telegraph Works Co., Ltd., and to fill the vacancies **Mr. J. N. Aldington,** B.Sc., Ph.D., M.I.E.E., F.I.E.S., group managing director of Siemens Edison Swan, Ltd., and subsidiary companies, and **Mr. S. E. Goodall,** M.Sc.(Eng.),

Dr. J. N. Aldington

Mr. S. E. Goodall

M.I.E.E., F.Q.M.C., chief engineer of the company have been elected to the board.

Sir Edward Crowe had a long and distinguished career in Government service before entering industry. He is a director of the English Electric Co., Ltd.

Mr. McArthur has been with Henley's for over fifty-eight years and has held the successive appointments of technical officer (1929), assistant works manager, Woolwich (1930), works manager (1939), and works manager of Woolwich and Birtley rubber cable factories (1945-52). He was elected to the board in 1950.

Dr. Aldington is internationally recognised as an authority on illumination. From 1936 to 1939 he was research physicist and head of laboratories of the Siemens Lamp

Mr. G. B. Proctor, managing director, Transformers (Watford), autographing the silver key presented to him. With him (left to right) are Mrs. Hunt (representing the employees), Miss Westwood, Miss Hoare (publicity manager), and Mr. E. Osborne (chairman of the T. W. Sports and Social Club)

Works, Preston, and from 1939 to 1948 was assistant works manager and head of laboratories. In addition to his being group managing director of the Siemens Edison Swan group of companies he is chairman of Submarine Cables, Ltd., and a director of Associated Electrical Industries, Ltd. He is a past-president of the Illuminating Engineering Society, which awarded him the Leon Gaster Premium in 1942 and again in 1946. The I.E.E. also awarded him the Crompton Premium in 1946 as a joint author.

Mr. Goodall, who has been associated with Henley's since 1944, received his education at Queen Mary College, University of London. From 1924 to 1928 he was with Siemens Bros. & Co., Ltd., Woolwich, after which he was in the research department of the Metropolitan-Vickers Electrical Co., Ltd. He joined Henley's as assistant chief engineer, and in the following year was appointed deputy chief engineer, becoming chief engineer when Dr. P. Dunsheath relinquished that position to become consulting engineer to the company in 1946. Mr. Goodall's outstanding contribution to the electrical industry has been recognised by the Institution of Electrical Engineers, which elected him as President for the current year. He had previously served for two periods on the I.E.E. Council and was elected a vice-president in 1953. He was also chairman of the Supply Section for 1950-51.

Mr. A. J. Gray, B.Sc., A.M.I.E.E., has been appointed general works manager of Ferranti, Ltd., following the retirement of **Mr. W. Hunt,** M.B.E., J.P. Mr. Gray joined Ferranti, Ltd., in 1935 and was works manager of the company's Transformer Department from 1946 until taking up his new appointment. **Mr. G. R. C. McDowell,** B.Sc., succeeds Mr. Gray as works manager of the Transformer Department.

Mr. A. J. Gray

Mr. R. James, O.B.E., Wh.Sch., D.I.C., M.I.Mech.E., A.R.C.S., has relinquished his appointment as a member of the South Wales Electricity Board which he has held since its inception in 1948.

Mr. S. H. P. Joseph, Associate I.E.E., manager of the Otley District of the Yorkshire Electricity Board, retired on 31st December after thirty-eight years' service in the industry. He was recently presented with a hallrobe on behalf of the staff of the Otley District and his colleagues in the Sub-Area, at the annual district staff dance. He is succeeded by **Mr. N. Shackleton,** A.M.I.E.E., A.M.I.Mech.E., who was previously manager of the Skipton District of the Board.

Mr. F. Roscoe, A.M.I.E.E., who has been appointed manager of the Skipton District to succeed Mr. Shackleton, received his early training with Callender's Cable & Construction Co., Ltd., and later with the Yorkshire Electric Power Co., becoming assistant district engineer with the latter company in 1934. Throughout the war he served in the Royal Corps of Signals and attained the rank of major. On demobilisation he returned to the Yorkshire Electric Power Co. as an assistant system control engineer, and upon nationalisation became a system control engineer with the Yorkshire Electricity Board. For the last 3½ years he has been in charge of the Board's Rodley regional control centre.

Mr. F. Roscoe

Further appointments are announced in the new Cables Division of Siemens Edison Swan, Ltd., as part of the company's reorganisation. **Mr. D. E. Beavan** is home cable sales manager; **Mr. R. G. Holland,** export cable sales manager; **Mr. D. G. Skinner,** telephone cable sales manager; **Mr. H. S. Peet,** distribution equipment sales manager; **Mr. J. A. C. Kendle,** wiring accessories sales manager; **Mr. J. C. E. Coomber,** contract sales manager; **Mr. R. B. Tucker,** assistant home cable sales manager; **Mr. H. E. Helwig,** associations liaison officer; and **Mr. P. W. Kilroy,** special projects sales manager.

Mr. H. V. Potter retired as chairman of Bakelite, Ltd., on 1st January but continues as a director. **Mr. S. Adams** (vice-chairman) has been elected chairman.

The annual general meeting of the Manchester and District Branch of the **Electrical Industries Benevolent Association** will be held on 27th January (5.30 p.m.) at the Engineers' Club, Albert Square, Manchester.

Mr. L. Brown has been appointed manager of glass and component sales to the A.E.I. Lamp & Lighting Co., Ltd., Melton Road, Leicester. He joined the British Thomson-Houston Co., Ltd., at Rugby in 1928 and served in the lamp works there in various capacities under Mr. T. J. Dagley (a director of A.E.I. Lamp & Lighting Co., whose retirement was announced last month). In 1943 Mr. Brown was appointed accountant at the company's Chesterfield glassworks, but after six years there returned to Rugby as commercial assistant in charge of glass sales.

"ELECTRICAL WHO'S WHO"

There are nearly 8,000 entries in the fifth edition of the "Electrical Who's Who," which covers people in all branches of the industry and profession. Copies can be obtained, at 27s 6d (plus 1s 6d postage), from Electrical Review Publications, Ltd., Dorset House, Stamford Street, London, S.E.1

Mr. C. W. Embers has been appointed to the head office staff at the Tottenham Works of the Benjamin Electric, Ltd., as senior sales engineer responsible for liaison with architects and consultants throughout the British Isles. He has been with the company as a sales engineer since 1937, covering Bedfordshire, Hertfordshire and North Middlesex. **Mr. A. I. Simper,** at present covering Central London, takes over the duties previously carried out by Mr. Embers.

Mr. C. W. Embers

OBITUARY

Mr. R. Moxham, manager of the G.E.C. factory at Broad Oak, Portsmouth, died on Christmas Day at the age of fifty. He was largely responsible for the rapid growth of this unit, where precision electronic work for defence is carried out. He joined the G.E.C. in 1933, and in 1939 was appointed chief inspector of the radio communications group at Coventry. After the war—during which he was engaged in major work on the development and production of v.h.f. equipment for the R.A.F.—Mr. Moxham was appointed technical services manager at the company's Telephone Works. In 1953 he took a leading part in planning the Broad Oak factory, of which he was appointed manager. Mr. Moxham was a member of the British Institute of Management and served on the Radio Industry Council as representative on the Southern Regional Council for Further Education.

Mr. S. G. Orchard, of the Simplex Electric Co., Ltd., died on 29th December at the age of sixty-four. The funeral took place at Bristol on 1st January. After four years' service in France and Belgium in the 1914-18 war, Mr. Orchard joined the Bristol staff of Simplex Conduits, Ltd. (as the company was then known) in 1920. Within 3½ years he became branch manager, a post he held until 1955 when he relinquished it on his appointment to special duties.

Dr. H. Sulzer.—The death occurred on 5th January of Dr. Hans Sulzer, who was for many years head of Sulzer Brothers, Winterthur, Switzerland.

New Year Honours

Electrical Men in the List

The New Year Honours List published last week includes fewer electrical men than usual. From the list we have selected the following:—

Knighthoods have been conferred upon **Ald. I. J. Hayward,** J.P., Leader of the London County Council and chairman of the London Electricity Consultative Council; **Mr. R. P. Linstead,** C.B.E., Rector of the Imperial College of Science and Technology, University of London; **Mr. D. W. Logan,** Principal of the University of London; and **Mr. K. T. Spencer,** C.B.E., Chief Scientist, Ministry of Power.

Mr. P. D. Proctor, C.B., Permanent Secretary, Ministry of Power, becomes

Ald. I. J. Hayward (Knight)

Col. D. McMillan (C.B.)

a Knight Commander of the Order of the Bath (K.C.B.), and new Companions of the Order (C.B.) include **Col. D. McMillan,** O.B.E., B.Sc.(Eng.), M.I.E.E., Director of External Telecommunications, General Post Office. **Sir Frederick A. Minter,** K.C.V.O., chairman of the Berkeley Electrical Engineering Co., Ltd., becomes a Knight Grand Cross of the Royal Victorian Order (G.C.V.O.).

C.B.E.

In the list of Commanders of the Order of the British Empire (C.B.E.) are **Major H. A. Ashdowne,** F.R.S.A., B.Sc.(Eng.), M.I.E.E., Regional Director, North Western Region, G.P.O.; **Mr. P. T. Fletcher,** B.Sc.(Eng.), M.I.Mech.E., M.I.C.E., M.I.E.E., deputy managing director, Industrial Group Headquarters, Risley, Atomic Energy Authority; **Mr. S. E. Clotworthy,** B.Sc.(Eng.), M.I.E.E., managing director, Northern Aluminium Co., Ltd.; **Mr. J. G. Mackay,** chairman, Rustyfa, Ltd.; **Mr. L. T. Morton,** J.P., joint managing director, Clarke, Chapman & Co., Ltd.; **Mr. J. A. Ratcliffe,** O.B.E., F.R.S., M.A., M.I.E.E., chairman, Radar and Signals Advisory Board, Ministry of Supply Scientific Advisory Council; **Mr. J. H. Reed,** managing director, Ericsson Telephones, Ltd.; and **Mr. J. McWaters Storey,** managing director, Dewrance & Co., Ltd.

O.B.E.

New Officers of the Order of the British Empire (O.B.E.) include **Mr. R. F. Ballard,** general manager, Kolster-Brandes, Ltd.; **Mr. L. Essen,** D.Sc., Ph.D., A.M.I.E.E., senior principal scientific officer, National Physical Laboratory, Department of Scientific and Industrial Research; **Mr. C. S. Jenkins,** lately Regional Director, North Midlands Region, Ministry of Power; **Mr. H. R. Jones,** telecommunications controller, Wales and Border Counties, G.P.O.; **Mr. P. W. Mummery,** senior principal scientist, Reactor Division, Atomic Energy Research Establishment, Harwell; **Lady Carew Pole,** chairman, South Western Electricity Consultative Council; and **Mr. E. F. Wheeler,** D.L.C., M.I.E.E., superintendent engineer, transmitters, B.B.C.

M.B.E.

Among the new Members of the Order of the British Empire (M.B.E.) are **Mr. J. H. Baxter,** apprentice training and welfare officer, Parsons Marine Steam Turbine Co., Ltd., Wallsend-on-Tyne; **Mr. W. D. Childs,** telecommunications technical officer, Grade I, Southern Division, Ministry of Transport and Civil Aviation; **Mr. A. E. Denton,** works manager, S. G. Brown, Ltd., Watford; **Mr. A. C. Emery,** chief draughtsman, Telecommunication Group, Plessey Co., Ltd.; **Mr. G. F. R. Grenyer,** station radio officer, Government Communications Headquarters; **Mr. I. H. Hogg,** B.Sc., A.M.I.E.E., a senior research planning officer, Research and Development Branch, Industrial Group Headquarters, United Kingdom Atomic Energy Authority, Risley; **Mr. W. H. Jarvis,** F.R.S.A., A.M.I.E.E., engineer-in-charge, Independent Television Authority Transmitting Station, Bolton; **Miss Jean Margaret Kirk,** senior private secretary, North of Scotland Hydro-Electric Board; **Mr. R. D. Petrie,** A.M.I.E.E., head, Sound

Mr. R. F. Ballard (O.B.E.)

Dr. L. Essen (O.B.E.)

Apparatus Section, Designs Department, B.B.C.; **Mr. T. P. Pitloh,** executive engineer, Newcastle-on-Tyne, G.P.O.; **Mr. P. C. Ruggles,** senior engineer, English Electric Valve Co., Ltd., Chelmsford; **Mr. D. Sleath,** chief draughtsman, Instrument Department, Laurence, Scott & Electromotors, Ltd.; **Mr. W. S. Stambridge,** consultant, Rubery, Owen & Co., Ltd.; **Mr. M. D. W. Stonehouse,** M.I.E.E.,

Mr. M. D. W. Stonehouse (M.B.E.)

Mr. F. R. Warner (M.B.E.)

distribution liaison technical engineer, Electricity Council; **Mr. D. C. Walker,** B.Sc.(Eng.), A.M.I.E.E., senior executive engineer, Research Station, G.P.O.; **Mr. F. R. Warner,** head of the Sales Department (Contracts Division), General Electric Co., Ltd.; **Mr. F. C. Wells,** experimental officer, Signals

Maj. H. A. Ashdowne (C.B.E.)

Mr. P. T. Fletcher (C.B.E.)

Mr. S. E. Clotworthy (C.B.E.)

Mr. J. A. Ratcliffe (C.B.E.)

Mr. J. H. Reed (C.B.E.)

Research and Development Establishment, Ministry of Supply; and **Mr. P. J. Elliott,** resident engineer, Livingstone power station, Northern Rhodesia.

B.E.M.

Recipients of the British Empire Medal (B.E.M.) include the following:—**Mr. R. Asher,** foreman electrician, Lincoln power station, East Midlands Division, C.E.G.B.; **Mr. J. Ballantyne,** chief inspector, Fawcett, Preston & Co., Ltd., Cheshire; **Mr. H. E. Bonner,** electrical maintenance engineer (for services in connection with the British Government Pavilion, Brussels Exhibition); **Mr. W. G. Brett,** chargehand transport driver, Southern Electricity Board, Southampton; **Mr. H. Burdett,** chargehand fitter (electrical) with the Ministry of Works; **Mr. R. W. M. Burns,** D.C.M., technician, Class I, Telephone Manager's Office, Lancaster; **Mr. F. A. Dann,** Technical Class, Grade II, No. 4 Ground Radio Servicing Squadron, R.A.F., Chigwell (Hastings); **Mr. J. Darlington,** chargehand circulating water plant attendant, Ribble power station, North West, Merseyside and North Wales Region, C.E.G.B., Preston; **Mr. F. J. Fisk,** technical officer, East Telephone Area, London; **Mr. J. Grundy,** grinder, Joseph Lucas (Electrical), Ltd., Birmingham; **Mr. H. E. Hoggard,** general foreman, Scarborough District, North Eastern Electricity Board; **Mr. A. H. Hunt,** general foreman, British Thomson-Houston Co., Ltd., Leicester (Rugby); **Mr. W. McKay,** foreman tester, Drysdale & Co., Ltd., Glasgow; **Mr. C. Meikle,** electrical instrument tester with the Record Electrical Co., Ltd.; **Mr. G. W. Nicholson,** valve shop foreman, Richardsons, Westgarth (Hartlepool), Ltd.; **Mrs. Hannah Salter,** winding supervisor, Rotax, Ltd.; **Mr. T. V. Stevenson,** district foreman, Electricity Board for Northern Ireland (Banbridge, Co. Down); **Mr. F. Stockton,** mains foreman, North Western Electricity Board (Rochdale); **Mr. B. W. H. Turner,** general foreman (assistant), Eastern Electricity Board (Romford, Essex); **Mr. C. E. Webb,** clerk of works (electrical), Grade II, War Office (Belfast); **Mr. A. J. Welberry,** technical officer, Post Office Radio Station, Oxford (Witney); **Mr. S. H. Whitehead,** foreman electrical fitter, Leicestershire and Warwickshire Sub-Area, East Midlands Electricity Board (Hinckley); and **Mr. Koh Peng Yam,** assistant foreman, Electrical Department, Singapore Harbour Board, Singapore.

Control Room Lighting at Chapelcross

Fluorescent lighting has been used in the control rooms of the new United Kingdom Atomic Energy Authority Chapelcross power station at Annan, Dumfries.

In the turbine hall control room the central working area is lighted to an intensity of 25 to 30 lumens per sq ft by 12 A.E.I. twin-lamp fluorescent reflector units mounted above opal "Perspex" panels in a square laylight. The panels hinge open to give easy access to the lamps and the gear for the lamps is mounted remotely in specially designed boxes.

The lighting intensity of 20 to 25 lumens per sq ft on the vertical faces of the control panels is provided by directional lighting from "Mazda" fluorescent lamps housed in angled troughing set into the edge of the ceiling feature surrounding the central laylight. Thirty-two 5ft 80 W lamps are housed behind the louvering in this feature, which is 8in lower than the level of the surrounding suspended ceiling. Troughing and louvres are built in sections, butted together to form a continuous lighting run with four mitred corner boxes completing the square. The louvres direct the light mainly on to the control panels arranged in square formation below.

The peripheral lighting at the rear of the panels is provided by 20 single-lamp louvred fluorescent fittings (A.E.I. type FX 1208) recessed into the suspended ceiling. For emergency lighting 60 and 100 W g.l.s. tungsten lamps are included in the direct lighting area above the laylight, and in the surround feature. The scheme was designed by the A.E.I. Lamp & Lighting Co. in conjunction with the architects, Messrs. L. J. Couves & Partners, and consulting engineers, Messrs. Merz & McLellan.

Special lighting has also been installed in the four reactor control rooms. Approximately 90 A.E.I. fittings are used in each control room.

Above: Fluorescent lighting in the turbine hall control room of the Chapelcross atomic power station. Left: One of the four reactor control rooms at Chapelcross. A.E.I. fluorescent lighting fittings are mounted above a luminous ceiling of opal "Perspex" panels

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £180 0s 0d
COPPER, H.C. Electro	ton £221 5s 0d
Fire Refined 99·70%	ton £220 0s 0d
Fire Refined 99·50%	ton £219 0s 0d
COPPER Tubes ..	lb 2s 2d
Sheet	ton £249 5s 0d
H.C. wire and strip ..	ton £270 15s 0d
LEAD, English ..	ton £73 5s 0d
Foreign	ton £72 0s 0d
MERCURY	flask £74 0s 0d
TIN, block (English) ..	ton £750 10s 0d
ZINC, G.O.B. Foreign	ton £75 15s 0d
BRASS Tubes (solid drawn)	lb 1s 9½d
Wire	lb 2s 6¾d
PHOSPHOR BRONZE Wire	lb 3s 11½d
PLATINUM	oz £19 10s 0d
RUBBER, No. 1 R.S.S. spot	lb 25⅝d—25¾d

Street Lighting Schemes

St. Helier, Jersey, is to have more of its gas lighting replaced by electricity. Streets included in work now in hand include several main thoroughfares and a number of small side roads. The Jersey Electricity Co. plans to install Class "A" fluorescent lighting in the main streets and Class "B" fluorescent lighting in subsidiary ones.

Sodium lighting in Leicester Road, **Glenfield (Leics.),** is to cost £3,360.

Blyth Town Council is seeking sanction to borrow £5,779 for extensions to the sodium lighting in Newsham Road, Blyth.

INDUSTRIAL NEWS

Electrical Engineers' Exhibition

The Association of Supervising Electrical Engineers is again presenting two silver plaques to exhibitors at the Electrical Engineers' Exhibition (Earls Court, 17th-21st March) who show items adjudged to be the best in their class—industrial or domestic. Entry forms have been sent to exhibitors and they are returnable by 20th February to the Association's head office, 23, Bloomsbury Square, London, W.C.1.

Lord Brabazon has consented to open the exhibition on 17th March. As this year marks the golden jubilee of the Illuminating Engineering Society the organisers of the exhibition are arranging special lighting displays at Earls Court, including a model shop window and a demonstration of light, colour, sound and animation. Other special exhibits will be a 40-ton diesel-electric locomotive and a new "optic" which is to be installed in the Eddystone Lighthouse. Education and training will again receive attention.

Hotpoint National Sales Conference

Sales personnel from A.E.I.-Hotpoint head office and sales representatives from offices throughout the country met at Llandudno on 22nd and 23rd December for their second national sales conference. A flag bearing the slogan "Hotpoint Rockets Ahead" flew over the headquarters at the Winter Gardens ballroom. In addition to a number of addresses, a visit was paid to the Llandudno factory, where the representatives saw "Countess" and "Princess" washing machines and Hotpoint refrigerators in production. Closed circuit television was employed as an additional feature. During the conference Mr. R. Isdell-Carpenter (sales director) presented awards to the winners of the company's national sales contest.

Remote Control Equipment Exhibition

The Electrical Remote Control Co., Ltd., is holding on 10th and 11th February an exhibition of electrical timing and automatic control equipment at the Engineering Centre, Stephenson Place, Birmingham, 2. The exhibition will be open from 10 a.m. to 9 p.m. on both days.

South Western Electricity Board Prizes for Students

The part played by Ald. H. M. Medland, J.P., in the development of the electricity supply industry in the West Country is to be commemorated by the annual award of three prizes to students of electrical engineering at Plymouth and Devonport Technical College. Ald. Medland had been a part-time member of the South Western Electricity Board for nearly ten years when he retired from the Board at the end of December. Announcing the new awards at a luncheon in Plymouth on 2nd January in honour of Ald. Medland, Mr. A. N. Irens, chairman of the Board, said that they proposed to award one prize of £10 and two prizes of £5 each annually to the three best students taking courses in electrical engineering and installation.

Stainless Steel Production

An extension to the works of Spartan Steel & Alloys, Ltd., was officially opened by the Lord Mayor of Birmingham, Alderman Donald Johnson, when he inaugurated a new electric arc furnace last month. This completes the company's present development programme which, at a cost of some £150,000, has established in Birmingham one of Britain's most modern foundries for the production of alloy steel ingots. The foundry is equipped with a liquid oxygen plant for the lancing of steel and new laboratory facilities for exercising precise metallurgical control over production.

The new furnace was ordered from Birlec, Ltd., in August, 1957, when Spartan Steels & Alloys, Ltd., was formed by the parent company, Leopold Lazarus, Ltd. The furnace, which is equipped with a specially designed fume hood made by Tilghman's Patent Sand Blast Co., Ltd., is housed in a new foundry building 182ft long and 48ft wide. It has a nominal charge capacity of 3 tons of steel and is just over 7ft in diameter. The furnace shell is equipped with a water-cooled stiffening ring which prevents distortion under heat. Rated at 1,500 kVA, the unit has three 8in diameter electrodes which are automatically raised or lowered to maintain correct power input and arc length. In common with all Birlec arc melting furnaces of this size, provision is made for the entire furnace roof to be lifted clear of the shell, enabling scrap to be dumped directly into the furnace hearth from a charging bucket.

Pouring view of 3-ton Birlec arc furnace installed in the new foundry extension at Spartan Steel & Alloys, Ltd. It is the first of its kind to be installed in Birmingham for casting stainless steel ingots

For tilting the furnace in either direction normal tilting gear has been provided: a pair of heavy steel rocker trunnions built integrally with the furnace shell engage with double flanged treads running on tracks mounted in the furnace foundations. To ensure safe operation, the furnace tilting gear is interlocked with the roof swinging and lifting mechanism.

The OFW oil-immersed transformer of British Thomson-Houston manufacture is housed in a separate substation built as an annexe to the main foundry extension. Two 15 cwt Birlec high-frequency furnaces have also been installed. These are alternately connected to the 600 kW supply by means of a changeover switch. Operating at 1,000 c/s from a B.T.H. motor-alternator set, the furnaces are mounted in a steel case and are of the magnetically shielded type. Both furnace bodies are arranged for hydraulic tilting and the 15 cwt charge is melted in approximately 45 minutes.

Technical Education Survey

A bibliographical survey reflecting the growth and development of technical and vocational education in the United Kingdom is the subject of the latest UNESCO publication in the Organisation's educational studies and documents series. It has been specially compiled by Mr. R. C. Benge, M.C., F.I.A., Lecturer in Bibliography in the Department of Librarianship of the North-Western Polytechnic, London, and is published by H.M. Stationery Office, price 5s.

The survey is divided into three parts. Part 1 (Legislation) lists statutes and governmental circulars and administrative memoranda with a brief explanatory note on each;

Part 2 (Official Publications) includes Ministry of Education reports and pamphlets, and reports published by other Government Departments; and Part 3 deals with other publications concerned specifically with technical and vocational education. Similar information is given separately for Scotland and Northern Ireland. To help readers who may not be familiar with educational terminology in Britain a small glossary is included, together with a general index.

Embargo List Amended

Further changes in the list of goods embargoed to the Soviet Bloc and China (*Electrical Review*, 22nd August, 1958) were published in last week's *Board of Trade Journal*. The group on electric generators is unaffected. Certain scientific instruments are removed from the list and others, as well as fissionable materials, are further qualified. Machinery for making nuclear reactors is one of the items that have been added.

Census of Distribution

First results of the 1957 Census of Distribution and Other Services are included in the *Board of Trade Journal* of 2nd January. They show a very substantial increase in the turnover of radio and electrical business since 1950. In the latter year 10,153 radio and/or electrical goods shops reported an aggregate turnover of £85·4 million; they employed 43,657 people. By 1957 the number of shops had risen to 11,848 with a turnover of £226·7 million and 64,145 employees. The 1957 figures relating to electricity showrooms were as follows, the 1950 equivalents being given in parenthesis:—Number 1,257 (1,107); turnover £32·8 million (£16 million); number of employees 12,327 (5,403).

Temperature Measurement

Two pamphlets have been received from George Kent, Ltd., Luton, Bedfordshire. Publication No. 1517 is an illustrated spare parts list for mercury-in-steel temperature units used in the "Commander" range of instruments. The second publication, No. TP5039, is a reprint of a paper by Mr. G. H. Oughton, technical director of the Foster Instrument Co., Ltd., dealing with primary elements for temperature measurement. Divided into three main sections, resistance thermometer elements, thermocouples and radiation pyrometers, the paper considers the principles, construction and performance of each type of element, with special reference to application techniques.

Directory of Opportunities

The 1959 edition of the "Directory of Opportunities for Qualified Men" has now been published by the Cornmarket Press, Ltd., 1, Lower James Street, London, W.1, price 8s 6d, as a companion volume to the "Directory of Opportunities for School Leavers" and the "Directory of Opportunities for Graduates." Details of careers offered by nearly 100 major employers are given and chapters on such subjects as aptitude and the management of men are followed by a reference section which sets out in detail information about commercial and industrial organisations and Government Departments. A classified index summarises in tabular form further information concerning the size of the organisations and another index refers men and women with particular qualifications to the organisation recruiting them. There is also an extensive list of courses designed to give qualified men and executives a wider view of their own work or to keep them acquainted with events in allied industries.

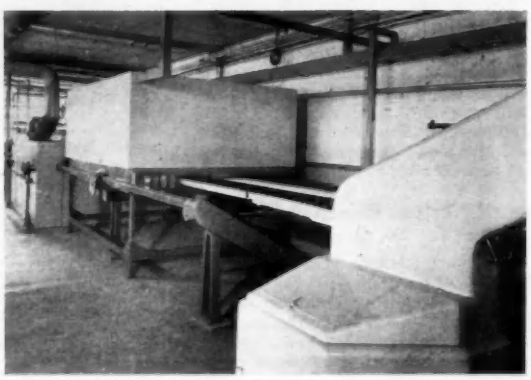
Heating and Ventilating Year Book

The twelfth "Year Book of the Heating and Ventilating Industry" has been published by Technitrade Journals, Ltd., 8, Southampton Row, London, W.C.1, price 10s 6d. Compiled in collaboration with the Association of Heating, Ventilating and Domestic Engineering Employers, whose address is 58, Victoria Street, Westminster, London, S.W.1, the book provides technical, contractual and other trade information in one compact volume. Such subjects as environmental radiation, ventilating problems associated with radioactive substances and the future of electricity for space heating are dealt with.

Infra-red Nylon Setting Plant

Infra-red heating plant provides the uniform heating required for setting, in less than 15 sec, fabrics woven from synthetic fibres, avoiding oxidation and consequent fabric discoloration. In two nylon setting plants developed by the General Electric Co., Ltd., and recently installed for Glasgow and Manchester firms, the heating is by radiation from sheathed wire elements mounted in panels 40in long suspended on a floor-standing framework above the fabric, which moves on a stenter at approximately 12 yd per minute. The elements, which are arranged at a small angle to the stenter to produce even heating, are graded from the centre, the outer elements having a slightly higher rating to compensate for the greater heat losses from the fabric edges. Groups of elements are switched independently, enabling the effective width of the plant to be varied to deal economically with a range of fabric widths.

Radiation reflectors are fitted behind the elements, and movable mechanically operated side reflectors can be positioned to maintain efficiency with any fabric width. The temperature of each plant is regulated by element switching, the output of a thermocouple attached to a special metal foil placed close to a heating element being fed to an electronic controller. Safeguards are incorporated to prevent damage by overheating should the fabric movement be interrupted, the supply to the elements being automatically cut off and the heating panels raised from the working position.



Infra-red setting plant with maximum heating capacity of 95 kW

Cranes for P.L.A.

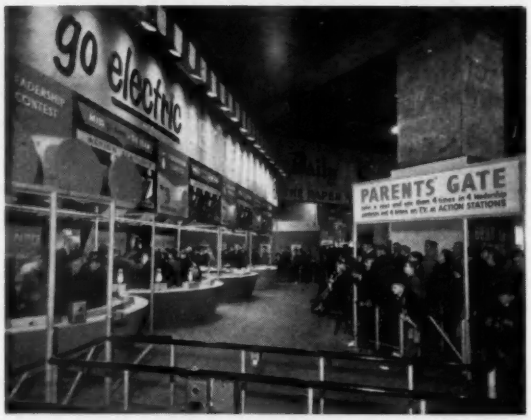
Seven new cranes have recently been ordered by the Port of London Authority for No. 4 Berth, Royal Victoria Docks. They are to be supplied by Stothert & Pitt, Ltd., with controls by the Igranic Electric Co., Ltd. The cranes will be of five-ton and three-ton capacity and will give greater handling speeds by means of special control features.

Radio Servicing Certificate Examinations

The dates of the radio servicing certificate examinations of the Radio Trades Examination Board are as follows:—Radio: Written papers, 5th and 7th May; practical test, 9th or 30th May. Television: Written papers, 11th and 13th May; practical test, Saturday 6th or 27th June. Entries must be received by the Board not later than 1st February (radio) and 15th January (television). Application forms and copies of the regulations can be obtained from the secretary, the Radio Trades Examination Board, 9, Bedford Square, London, W.C.1.

CIBA Fellowship Trust

The CIBA Fellowship Trust has been founded for the purpose of improving and increasing the interchange of ideas between scientists in the United Kingdom and on the Continent, with Sir Arthur Vere Harvey, Lord Hives and Professor Sir Alexander R. Todd as trustees.



Queues of schoolboys, such as those shown above, were a common sight at the E.D.A. stand during the entire run of the Schoolboys' Exhibition

Several fellowships will be awarded by an advisory panel for tenure during the academic year 1959-60 at Continental universities or institutions for research in chemistry, physics or some other allied scientific subject. Further details are available from the secretary of the CIBA Fellowship Trust, CIBA (A.R.L.), Ltd., Duxford, Cambridge.

Technical Abstracts

The first edition has been issued by the Lead Development Association of a publication, "Technical Abstracts," giving in tabulated form information on current literature about lead and its uses and, in a second section, brief notes on some of the latest patents concerning the applications of this metal. It is proposed that future editions shall be issued quarterly, and applications for regular copies, free of charge, should be made to the Lead Development Association, 18, Adam Street, London, W.C.2.

Electrical Travel Agency

Under the name "Electratours," a travel agency has been formed to offer special terms to people employed in the electrical industry when travelling abroad on holiday or business. We are told that all tours will be conducted on the highest standards. Particulars can be obtained by sending a stamped addressed envelope to Mr. D. H. Dyke, Electratours, 46, Mount Ararat Road, Richmond, Surrey.

Schoolboys' Exhibition

This year's National Schoolboys' Own Exhibition was, for the first time, staged at Earls Court, London, and because of the extra space available many of the exhibitors were able to devote more room to their displays. The stand of the British Electrical Development Association was no exception and there could have been little doubt in the organisers' minds when the exhibition closed last Tuesday that the Association's exhibit was probably their best effort so far.

The theme was "Go Electric—Beat the Gong Show" and boys and girls, in groups of twelve, were invited to carry out various tasks on the farm, factory, office and home, using old fashioned methods, in competition with a "Miss Electra," who had the aid of electricity. The children were, of course, unable to win the contest but the fastest team in each section, over the course of the exhibition, received a prize. All were, however, able thoroughly to enjoy themselves and spent a fascinating twenty minutes during which they had the opportunity of seeing and experiencing the benefits of electricity. Afterwards each youngster was given a "careers guide card," to insert in a battery of nine punched card computers. Depending on his or her answers to a series of questions, the youngster's aptitude for any one of four careers in the electrical industry was discovered.

Another feature of the stand was the use that was made of closed circuit TV, believed to be the first time that it has been used for genuine exhibition purposes. Four cameras were used and parents were able to follow the progress of their children on 16 large screens.

Electrical Refresher Course

The North London Branch of the Association of Supervising Electrical Engineers is sponsoring an electrical refresher course at Enfield Technical College. The course is limited to a maximum of 60, of which a number of places have already been allocated, and as enrolment will be taken in rotation as received, applications should be made as soon as possible. The fee (£1) is payable with the application to enrol and should be sent to Mr. E. Copeland (branch chairman), 26, Crossway, Bush Hill Park, Enfield.

Price Reductions

Semiconductors, Ltd., announces that with steadily increasing production at the new Swindon plant, it has been possible to make substantial price reductions throughout its full range of high frequency transistors. The new price list, which became effective on 1st January, shows reductions of the order of 15 per cent to 20 per cent with additional discounts for large quantities.

Texas Instruments, Ltd., Bedford, manufacturers of silicon semiconductor devices, announce a third substantial price reduction within twelve months. The prices of almost all transistors and rectifiers have been reduced, some by as much as 35 per cent.

Substantial reductions in the list prices for immersion heaters are announced by A.E.I.-Hotpoint, Ltd., with effect from 1st January. The standard types of automatic 2 kW and 3 kW heaters in lengths of 10in to 30in are £2 5s plus tax. The Hotpoint two-purpose heater, the "Twimerser," is now listed at £5 plus tax. A new immersion heater price list and a new price list for storage heaters are being distributed.

Decca Mobile Unit

A new mobile marine demonstration unit has been constructed for Decca Radar, Ltd., and the Decca Navigator Co., Ltd., and was recently shown to the Press at the Royal Festival Hall. The body is built on a Commer 5-ton chassis and comprises a cabin with separate access lobby. Equipment includes two of the new D7 marine radars, the TM 909 and D 404, the Mark V Decca Navigator equipment and the Marine track plotter. The vehicle, which is the third of its kind operated by the company, will be shipped to Europe early in February to commence a six months' programme covering well over 6,000 miles.

Weld Pre-Heating

The application of electrical resistance heating for pre-heating and stress relieving welds is described in a pamphlet, No. 321, issued by Electrothermal Engineering, Ltd., 270, Neville Road, London, E.7. Armoured heaters comprising insulated nickel chrome resistance wire covered with a flexible nickel alloy sheath, having an overall diameter of $\frac{5}{16}$in, can be applied to flat or curved surfaces. The heaters are covered with 2in thick pre-formed sectional lagging capable

Welding a lagged, pre-heated butt joint

of withstanding working temperatures of 800 deg C (1,472 deg F) or more. Power supplies at the standard voltages used, 50, 70 or 100 V, may be obtained from either the welding generator or transformer, or through a separate transformer from the supply mains.

"Data Processing"

We have now received a copy of the first issue of "Data Processing," the quarterly journal whose publication we foreshadowed a few weeks ago. The journal is designed for "top management and chief executives" and accordingly deals with the various aspects of its subject in a way easily assimilable by very busy men; it eschews technical jargon but still conveys information on the operation and application of data processing methods and machinery in a sound way. This first issue is well produced and contains illustrated articles on a variety of germane subjects including explanations of computing service for business and industry, the "language" of computers, and the operation of an electronic digital computer. There is also an illustrated survey of British computers and their makers and among other subjects dealt with are automatic programming, wage accounts and labour costing and industrial inspection.

"Data Processing" is published by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1, at 25s per copy. Annual subscriptions are £4 home and overseas and $12 United States and Canada.

A.S.E.E. Annual Dinner

The annual dinner and reunion of the Association of Supervising Electrical Engineers will be held on 17th April at Grosvenor House, Park Lane, London, W.1. Tickets (£1 15s for members and £2 2s for others) can be obtained from the General Secretary, 23, Bloomsbury Square, London, W.C.2.

National Certificates

The procedure for the submission of candidates for the award of national certificates and diplomas is reviewed in the "Report of the Working Party on National Certificate Procedures." Further details and a supply of forms can be obtained from the Chief Registrar, Ministry of Education, Curzon Street, London, W.1.

Change of Name

Acme Wringers, Ltd., has changed its name to Acme Domestic Equipment, Ltd.

Gas-Filled Cable System

In a report of the discussion which took place at the Institution of Electrical Engineers on 17th December on the paper "The Design and Performance of the Gas-Filled Cable System," Mr. E. H. Ball was referred to as being with the A.E.I. In fact, he is employed by Pirelli-General Cable Works, Ltd.

Lamp Making Machinery for Kuwait

Luxram Electric, Ltd., recently received a contract worth nearly £45,000 from the Sheikdom of Kuwait for a unit for the production of standard lamps, vacuum and gas-filled, including the necessary auxiliary plant. It will be installed in a new factory to supply electric lamps not only for Kuwait but also in neighbouring territories.

Winnipeg Office Extensions

Siemens Edison Swan (Canada), Ltd., is adding 8,000 sq ft of floor area to its headquarters in Winnipeg. The extension will double the office and workshop space.

Trade Announcements

The distribution of "Dagenite" motor batteries in the United Kingdom and Republic of Ireland, hitherto undertaken by Holsun Batteries, Ltd., as sales concessionaires, has reverted to **Pritchett & Gold and E.P.S., Ltd.**, the manufacturers of the batteries. This change is for the purpose of administrative convenience and is one of form only. It will in no way affect the sales policy under which "Dagenite" batteries have been sold up to now. The main sales office will remain at 137, Victoria Street, London, and all the company's depots will still be as at present.

The board of **BTR Industries, Ltd.**, announce that an agreement has been reached in principle whereby the company acquires the whole of the capital of **Microcell, Ltd.**, and of the associated companies, Glass Yarns and Deeside Fabrics, Ltd., and Artrite Resins, Ltd. Mr. H. Kremer, chairman and managing director of Microcell, Ltd., will continue in that capacity and will join the board of BTR Industries, Ltd.

Allen West & Co., Ltd., are establishing, as from 19th January, a district office at Alliance House, 4, Clumber Street, Nottingham (telephone: Nottingham 46568/9). The branch office manager is Mr. A. Turner.

The **Plessey Co., Ltd.**, announces that an agreement for the interchange of technical information concerning the manufacture of cast permanent magnets of high energy, for use in the electronic and electrical industries, has been concluded with the Arnold Engineering Co., of Illinois. These magnets, which will be marketed under the registered trade mark of "Magloy," will be manufactured by Preformations, Ltd., a company formed by Plessey for the development and production of permanent magnets in this country. The directors of Preformations, Ltd., are Mr. A. G. Clark (chairman), Mr. A. E. Underwood and Mr. R. M. Arnold (U.S.A.). The company is with other Plessey group plants on the new Cheney Manor factory estate at Swindon, Wilts.

Stewart Transformers, Ltd., has appointed Law & Plumtree, Lansdowne Road, Erdington, Birmingham, 24 (telephone: Erdington 0460), as its representatives for the Greater Midlands area.

Alfred Herbert, Ltd., announce that they have acquired the whole of the issued share capital of the Holbrook Machine Tool Co., Ltd. (of Stratford and Harlow), makers of precision lathes.

S. N. Bridges & Co., Ltd., have opened a branch office and service depot at 19, Eastgate, Leeds, 2 (telephone: Leeds 31656/7), under the management of Mr. D. Noble.

C. P. Clare, Ltd., Dudden Hill Lane, N.W.10 (Willesden 5141), a company in the Elliott-Automation Group, announce that they have commenced the manufacture, under licence from C. P. Clare & Co., Chicago, U.S.A., of the Clare "F" relay.

Cooke, Troughton & Simms, Ltd., a company of the Vickers Group, has purchased the issued capital of C. Baker of Holborn, Ltd., optical instrument makers, with a works at Purley Way, Croydon, Surrey.

Hayward Tyler & Co., Ltd., Luton, and **Sumo Pumps, Ltd.**, manufacturers of electric submersible pumps, have established a joint office to serve their interests in the Midlands. Both concerns are members of Stone-Platt Industries, Ltd. The office is at Devereux House, Church Hill, Coleshill, near Birmingham (telephone: Coleshill 2233/4). Mr. N. Schofield, formerly trading as N. Schofield & Co., Ltd., at this address, is in charge. The territory covered by the new office includes Leicestershire, Northants, Shropshire, Staffordshire, Warwickshire and Worcestershire.

Lec Refrigeration, Ltd., has purchased the site of the Bognor Regis gas works for £35,000. The gas works closed down some five months ago.

Electric Depot, Ltd., has appointed W. C. Waterfield & Partners to represent it in the Midland area.

The South Eastern area office of **Birlec, Ltd.**, has been transferred to Crown House, Aldwych, London, W.C.2 (telephone: Temple Bar 8040). The South Eastern area office of **Birlec-Efco (Melting), Ltd.**, has also been established at this address.

Calendars

Texas Instruments, Ltd., has sent us a calendar showing three months on each card and bearing pictures in colour of Texas.

Nalder Bros. & Thompson, Ltd., have sent us a neat desk calendar, each card of which shows the current, preceding and following months.

Materials for the Electrical Industry

SUPPLIES AND PRICES DURING 1958

This is the annual review of the events which influenced the production and prices of the principal raw materials employed by the electrical manufacturing industry. It has been prepared for us by the Metal Information Bureau, Ltd.

COPPER.—The copper industry has just concluded another very eventful year, but the market ends 1958 in a much better condition than it began. When the year opened, the United States economy was undergoing a recession of sufficient magnitude for it to be described in some directions as a slump and this exerted a powerful influence on general market sentiment. European copper consumption was at a satisfactory level with the demand for wire at a high rate. This was helped materially by big Russian and East European buying. Russia is believed to have taken about 50,000 tons of wire and wire products from the United Kingdom alone in 1958. In January, Chile announced a cut in production to 90 per cent of the 1956 level and this move was followed by a similar one by the big Belgian producer. Prices on the London market in February fell to £160 10s—the lowest level since the war and, as it proved, the turning point in the long decline from £437 in March, 1956.

More producers announced reductions in output, the general pattern being a 10 per cent cut outside the United States but more extensive curtailment in America. With the prospect of the suspended American import duty being reimposed on 1st July some heavy speculative buying developed on the Commodity Exchange in New York, helped by the more hopeful feeling about the general economic outlook in the U.S.A.

In April there was a strike at the big Chuquicamata mine in Chile which, by the time it was settled in May, caused the loss of over 30,000 tons of production. The big Kennecott interests had brought their American output down to only 67 per cent of the 1957 level and with news of proposals by the U.S. Government to subsidise domestic production up to one million short tons a year to give producers a return of 27½ cents per lb (£220 per ton) prices improved to about £190.

Chile urged the United Nations to take urgent action to stabilise the price of copper, but at a meeting of the International Wrought Non-Ferrous Metals Council in May (representing fabricators in many countries and also attended by some leading producers) there was general opposition to the idea of an international commodity agreement for copper. In June, the American Government altered its plans for helping the domestic mining industry to a proposal to buy 150,000 tons for its stockpile at up to 27½ cents per lb. Heavy trading on the London and New York futures markets ensued and prices rose to £200 on this news. Later, this was finally—and unexpectedly—defeated in Congress. World producers' stocks began to fall as a result of the big aggregate cuts in output and shortly after the reimposition on 1st July of the 1·7 cents American import duty prices climbed to over £220. Electrolytic wire bars were in short supply in Europe and for non-contract business commanded premiums of £14 or more over the Metal Exchange price.

By August the situation had improved sufficiently for American producers to begin raising output progressively. Further strength was imparted by the C.O.C.O.M. recommendations in August permitting sales of raw copper to Russia and other communist countries. By the end of the year, the Soviet alone was estimated to have bought 40,000 to 50,000 tons of raw copper in addition to big wire purchases. A conference convened by the United Nations in London from 8th to 10th September decided that no international government action with regard to the regulation of supplies or prices was necessary.

A strike of European mineworkers on 13th September over the subject of job allocation, closed all the Rhodesian Copperbelt mines. Coming at a time when supplies outside America were not over-plentiful, this strike—which lasted 53 days—caused fears of shortage and covering buying by users, bringing prices early in November to £260 (for spot) with a backwardation of some £18. Metal Exchange warehouse stocks dipped to below 6,000 tons and fears of a seriously tight market position were allayed only by a relaxation of U.S. export restrictions. This caused a drop in the spot price of £20 in a week.

In October, world producers' stocks fell by no less than 106,000 short tons and a further 40,000 tons in November, a significant factor being substantial restocking by American consumers. Early in November the Board of Trade announced the sale of 10,000 tons of copper from U.K. Government stocks and later in the month stated that a further 7,500 tons would be sold. Towards the end of the year the re-negotiation of period pricing contracts in Europe led to an interesting tussle over whether a premium should be paid for electrolytic wire bars over the Metal Exchange price. The buyers were able to resist this, and although the London daily pricing method continues to attract a good deal of criticism it still governs the sale of very large tonnages of copper in the United Kingdom and elsewhere.

By the end of the year the market seemed steadier in the region of £220. Despite the recovery in America, however, it is generally agreed that with the at present indifferent economic prospects in Europe, available productive capacity—which is currently pretty fully utilised—should (in the absence of strikes or unforeseen developments) assure an adequate supply of copper during 1959.

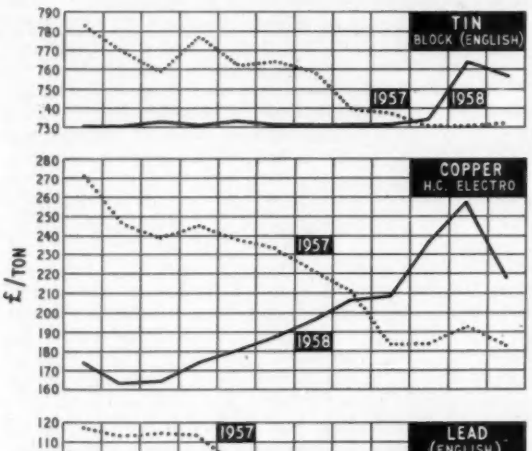
Last week the Board of Trade announced that it would offer for sale during 1959 the whole of its remaining stocks of copper, amounting to about 30,000 tons.

TIN.—The outstanding feature in tin has been the continuous struggle throughout the past year by the member countries of the International Tin Agreement to bring supplies and demand into such balance that prices move into, at any rate, the middle—and preferred—price range, i.e. £780 to £830 per ton. Curtailment of exports from the signatory producing countries began in December, 1957, and was stepped up retrospectively to a 40 per cent reduction in January. Even so, it took months to become fully effective. The Buffer Stock manager had to give constant support to the market at the minimum support price of £730.

Considerable nervousness about the ability of the control scheme to operate satisfactorily in the face of continued and unexpectedly large Russian exports of tin characterised the market and has never really left it, despite the strong measures taken by the International

Tin Council. In the final quarter of the year, the export cuts were raised to 48 per cent. For lengthy periods the forward price ruled at a discount from spot, often a substantial one.

The registration by the Soviet Union of its brand of refined tin on the London Metal Exchange brought direct pressure on the price the Buffer Stock was supporting, as Russian exports in total were now at an estimated annual rate of 16,000 to 17,000 tons. Some Chinese tin (which is also outside the control scheme) also began to appear on the world market. Buffer Stock holdings mounted rapidly and by the middle of the year exceeded 23,000 tons. A Special Fund had to be provided by some of the producing countries, the extent of which has never been divulged. Tin bought with this fund is not



subject to the same price limitations on purchase or sale as the original Buffer Stock.

American consuming demand remained slow, even when industrial activity there picked up, and British tinplate makers took considerably less tin owing to diminished sales.

In September, the Buffer Stock manager ran out of funds and ceased to support the spot price at £730. Quotations dramatically fell from £730 to £640 in a day and Great Britain, the Netherlands and Denmark imposed import quotas on Russian tin. At the lower levels, American consumers came in to buy on a substantial scale and other buyers also re-entered the market. Within a matter of weeks the price had more than recovered the lost ground and the statistical position continued to improve. Russia has promised to reduce her exports in 1959 (by an unspecified amount) and high-grade tin is by no means plentiful. Confidence, however, is still lacking as lengthy negotiations between the I.T.C. and Russia have so far failed to produce definite steps for the regulation of Russian supplies and the economy of producing countries is strained by the low level of production. Despite the theoretically strong statistical outlook, buyers generally are still maintaining a very cautious attitude. Consumption is better than it was and looks reasonably hopeful for 1959, but export restriction is maintained at 48 per cent for the first quarter of this year. The decision in December to permit producing countries to barter tin to the United States Government for stockpiling might afford some relief to producers.

LEAD.—The lead market opened 1958 under the shadow of the possibility of an increase in American import duties and the prospect of an early end to U.S. Government stockpiling of lead. This occurred in March. During 1957 the stockpile had taken large tonnages off the market, thus minimising the effect of a serious over-supply position on the world market. These factors depressed the open market here, but U.S. prices were maintained at a higher level and a good deal of metal was flowing to the United States in anticipation of higher tariffs. At the end of April, the U.S. Tariff Commission (in a divided report) recommended substantial increases in the import duties and the Republican representatives urged the imposition of import quotas as well. This policy, however, aroused strong opposition from lead exporting countries and as an alternative the U.S. Administration formulated a Minerals Stabilisation Policy. Under this, substantial subsidies were to be paid to the domestic primary producers.

In this period, whilst European consumption was on a reasonably good scale, business in America continued depressed and the world statistical situation was still top-heavy. Prices were unattractive and American mine output fell to the lowest level for some years, whilst Australia and some other countries also curtailed production. The American subsidy Bill was keenly debated in Congress, but at the end of August—most unexpectedly—was defeated. In September, a United Nations conference in London suggested a general cut in exports and production and the formation of an international study group.

On 1st October, the United States imposed import quotas of 80 per cent of the 1953-57 average imports and although this had a depressing long-term significance for the European market, the immediate effect was a hardening in prices owing to metal being hurried into the United States to get in under the first or second quota periods. The effect on the market was helped by the better level of American demand in the third and fourth quarters.

In November a further United Nations conference in Geneva resisted strong pressure by the United States and one or two other countries for cuts in supplies, but agreed to the formation of an international study group. A further conference is planned for next March.

The year ended with prices much about the same as they were at the beginning, having in the meantime dipped to just below £68 in August and reaching a peak of £77 10s in October/November. For the greater part of the year, the United Kingdom cable industry took appreciably less lead (83,810 tons in January-October, against 96,591 tons a year earlier) presumably under the influence of the Government's anti-inflation policy, now happily relaxed. The battery industry, on the other hand, showed some improvement over 1957 and so did solder. The prospects for 1959 on a world basis are not at present very exhilarating, despite the better level of American demand.

ZINC.—With the zinc price at the beginning of 1958 under £62 a ton, producers generally were very worried and mine output was progressively curtailed in a number of countries, and particularly in the United States. The world statistical position was seriously out of balance and the ending of U.S. Government stockpiling after March created a grave situation. In February the British Government suspended sales from its stockpile owing to the adverse market position. The U.S. Tariff Commission in April recommended substantially higher

import duties but, as in lead, the Government put forward an alternative plan to subsidise domestic production. It was eventually defeated by Congress and following a United Nations conference in London in September (which proposed that exports and output should be cut and an international study group should be formed) the U.S. Government introduced (on 1st October) import quotas on ore and metal of 80 per cent of the 1953-57 average figures.

Although this implied that additional supplies might come on to the European market, prices actually hardened for several reasons. A second U.N. conference, although rejecting for the time being export and/or production cuts, agreed to an international study group and a further conference in March, 1959.

United Kingdom consumption was adversely affected for most of the year by reduced requirements of the galvanising industry. Some sections of the brass trade experienced rather dull conditions. The New Year starts with prices at a better level than a year ago, but excess supply problems still loom on the horizon.

ALUMINIUM.—The decrease in aluminium prices which we adumbrated a year ago duly materialised, although it is fair to say that not many people expected that the Canadian producer (which is the world price leader outside the U.S.A.) would make a cut of the magnitude of £17 per ton, as was done in April, 1958.

The prospects of a further reduction in price are much less bright. To a large extent, this is because a settlement was reached on a proposal to impose an anti-dumping duty on Russian aluminium entering the United Kingdom. Submitted in February by the sellers of Canadian ingot, the application was answered in September. No duty was imposed, but it was announced that the Russian authorities had agreed that they would limit their exports to this country during the following twelve months. Since then Russian exports of aluminium, to all free world destinations, have dwindled away to a low level. It is, however, certain that the diminution in the volume of trade is not due to any change in consumers' desire to buy metal in the most advantageous manner. Despite the disadvantages which have been inherent in buying Russian metal (namely, for eligible consumers, the loss of the Canadian company's "loyalty rebate," now ended), there has been no lack of outlet for Soviet metal as long as it was up to £10 per ton under the Canadian price (before rebate). Since supplies began to diminish, however, prices have tended to harden in the market in Iron Curtain country metal.

While prices are, as we have said, less likely to go down, they will definitely not increase for those United Kingdom consumers who placed their first-half 1959 requirements with the Canadians before the end of 1958. Whilst the offer to deliver metal against such orders in the first half of 1959 at current prices (or less if a decrease becomes effective in the period) was, perhaps, not quite as generous as the six months' price freeze on all metal bought in the first half of 1959, which competition in the American market has made available to consumers there, it did, nevertheless, go a long way towards countering one of the perennial causes of complaint of purchasing officers—the practice of selling at price ruling at time of delivery. Aluminium is, indeed, now better than copper, which can be bought at a known price only for three months' forward delivery.

One thing seems quite certain about 1959—that supply of aluminium will be more than enough to meet demand; it should, indeed, be enough to secure continuance of buyers' market conditions.

IRON AND STEEL.—The year 1958 was fully expected by the British steel industry to be a relatively quiet one, but it felt reasonably sure that raw steel production in 1958 could be maintained at about 21 million tons. Events proved to be rather more disappointing, however. The earlier Government anti-inflation measures had made the holding of steel stocks unattractive and consumers, in the knowledge that the vast increase in steel capacity made stocking less necessary, began to reduce their reserves, which had been built up in the abnormal times since the war to very large proportions. Added to this the export market was affected by the general world recession and exports began to fall away, while towards the end of the year there were signs that actual consumption of steel in this country was beginning to decline in some branches.

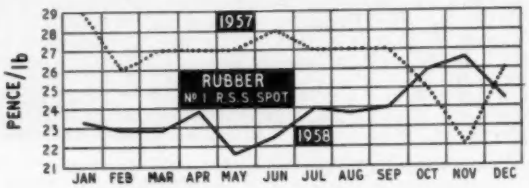
As a result it now seems unlikely that the steel industry was able to produce even 20 million tons of raw steel—the figure was probably close to 19½ million tons, compared with an expected 21 million tons and the capacity of 23½ million tons. This decline must in no way be considered catastrophic. Fall in steel demand has been fairly general throughout the world, and few major steel-making countries have escaped the consequences.

Pretty well the whole range of finished products has been affected by the recession, with the notable exception of sheet steel. Throughout 1958 the motor industry has worked at record levels, and it has been obliged to import sheet steel in order to cover its needs. Tinplate has recovered somewhat from its decline in the autumn of 1957, but demand for light sections, heavy sections and plates is, in varying degrees, less than eighteen months ago.

Not unnaturally, imports of iron and steel during this year have dwindled to negligible proportions and in October reached the lowest level for about 10 years (only 28,734 tons were brought in, and of this a large part—10,082 tons—comprised sheet steel). Although exports had fallen some 16 per cent up to October the United Kingdom seems to have maintained its share of overseas markets in the face of very intense competition.

The steel makers are now adopting a cautious attitude. No "target" figure for steel output has been publicised, but on the strength of current conditions it may well be similar to the 1958 output. Yet many in the industry feel that the recession has "touched bottom." The Government has certainly done much to stimulate demand for steel, and its measures will gather momentum as 1959 progresses. At the moment, however, no one is expecting any great impetus to the steel trade before the autumn.

RUBBER.—Despite the American recession, especially in the motor car trade, world demand for natural rubber kept up very well during 1958. Indeed, thanks to a substantial volume of buying from Russia and other Communist countries, it is confidently expected that final figures will show a record amount of natural rubber to have been consumed during the past year. Prices have kept unusually steady throughout the year in the region of 1s 10d to 2s per lb for ribbed smoked sheet, apart



from a moderate rise for a time in October under the influence of a spurt of Eastern European buying. Output and consumption appear to have kept in reasonable alignment during the past twelve months.

With the American economy now looking much more hopeful than it did a year ago, it is expected that American demand for natural rubber will show an increase since it is believed that the United States has already reduced the percentage of natural rubber in relation to synthetic pretty well to the minimum in most applications. Whether 1959 will prove an even better one than its predecessor for the world as a whole will depend upon the volume of demand from the Soviet bloc. This is an unknown quantity, but if it equals the 1958 figure then a fresh record in consumption may be established.

Current prices arouse no great enthusiasm in the minds of producers but they seem to be economic for most estates. Any decided upward movement might aggravate the competition from synthetic rubber, particularly outside the United States.

RAILWAY RESEARCH

THE growing momentum of the electrification programme of British Railways has underlined the need for continuous investigation and research. A notable problem is that of adhesion between track and wheels of electric locomotives, and this and other problems are being investigated and solved at the Electrical Testing Laboratory set up at Willesden last year by the British Transport Commission.

On a raised length of permanent way, 100ft long, electric traction equipment can be tested either stationary or moving slowly. For most purposes it is sufficient to make measurements upon one bogie only, additional weights being used to represent the body. A supply of low-voltage d.c. power, earthed on one side, is provided by two Ward-Leonard motor-generator sets and is conveyed to the vehicle by third and fourth conductor rails. Since the vehicle is tested only at standstill or at very low speeds the full values of current, tractive forces and heating effects can be provided without the voltage of the conductor rail exceeding about 50 V.

In adhesion experiments, individual hand braking is provided for each pair of wheels. A group of knife switches, placed on one side of the vehicle, enables the two motors to be isolated, or connected individually or together in series or parallel in either direction. Stationary adhesion tests are usually made with the two motors of the bogie in opposition so that the effects of torque reaction are eliminated, but low speed tests may be made with one or both motors, the speed being limited by applying the hand brakes. Another feature of the equipment enables the track voltage to be raised to 750 V for tests involving such factors as track insulation, leakage, etc.

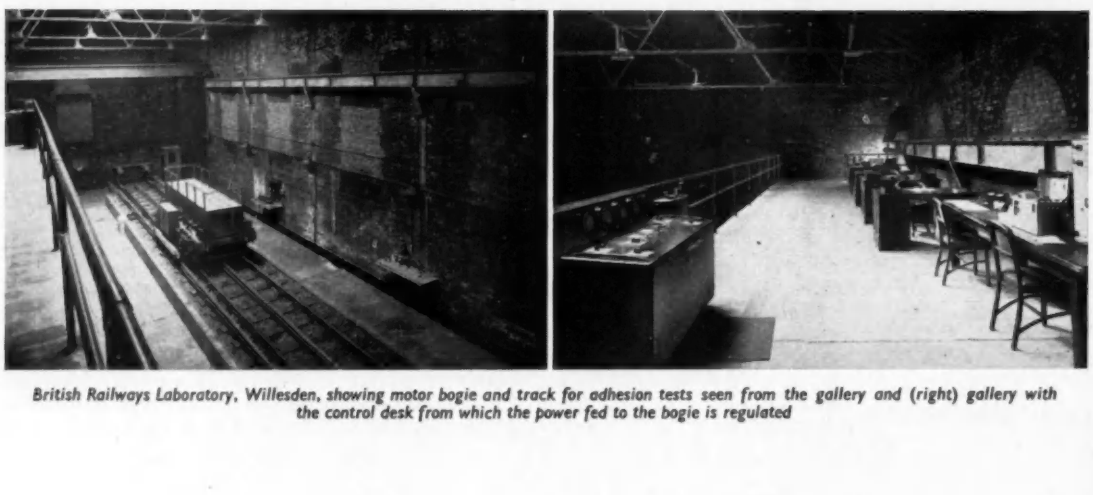
Although the laboratory was planned to give a high priority to the adhesion problem, the design of the installation is such that many different studies can be carried out. The work can include, for instance, the measurement of forces, currents, heating, etc., in all forms of electric traction equipment from locomotives, motor coaches, lengths of track, or sections of overhead contact lines, to individual items such as motors, contactors, collector gear and insulators. Space has also been left for items likely to be needed in the near future, such as a transformer and rectifiers for providing supplies of a.c. or rectified d.c. power, a motor test bed with automatic controls, or a rack for testing control gear.

National Scientific Library

PART of the former ordnance factory at Thorp Arch, near Boston Spa, Yorks., is to be taken over by the Department of Scientific and Industrial Research and used for a national lending library for science and technology. It will be opened in 1961 and come into full use during the following year.

The new library, to be developed from the D.S.I.R. lending library unit now at Chester Terrace, Regent's Park, London, will cover all fields of science and technology, excepting some medical subjects, and it will be responsible for the lending service now provided by the Science Museum library. It is also taking over some of the literature now held by this library. One important activity will be the expansion of work on the translation of Russian scientific literature, now organised by the lending library unit in collaboration with the National Science Foundation in the United States.

The present library has been collecting literature for the national library since 1957, and eventually much of the scientific and technological literature in the world will be included in this collection, to make it the most comprehensive of its kind in the United Kingdom.



British Railways Laboratory, Willesden, showing motor bogie and track for adhesion tests seen from the gallery and (right) gallery with the control desk from which the power fed to the bogie is regulated

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Contented Cows

I NOTICED in your notes "View on the News" of 12th December by "Reflector" a paragraph from an article from *Power* (New York) which stated that cows enjoy air conditioning and cooled drinking water during the summer.

It is also true that cows enjoy air conditioning in the winter as I have proved by fitting fans in shippons to take out hot air when the cows are tied up all day during the winter months.

One farmer for whom this work was done was well pleased with the fans. He said that he had increased his milk yield during the winter as a result of the scavenging action of the fans, which sucks out the humid air from the shippon and replaces it with fresh air. (There is quite a moist heat off the average cow which soon makes the shippon dripping wet.) So it would appear that there is something in the statement from *Power* of New York.

Weaverham, Ches. D. MACLAREN CATHCART, B.SC., M.I.E.E.

Building Construction and Space Heating

I HAVE read with interest the floor warming/structural insulation articles and correspondence which have appeared during the last month in the *Electrical Review*.

Nearly four years ago I designed and built that phenomenon, an all-electric, well-insulated, chimneyless house at a total inclusive cost of 45s/sq ft. Besides floor warming it has many novel, but to my mind essential, features which I have described and discussed publicly on a number of occasions.

The long-term effects of failure to recognise the dependence of economic whole-house heating upon suitable structural design and the complementary function of storage heating to instantaneous demand heating, may have an arresting effect upon the extension of the all-electric principle. It is abundantly evident, however, that fundamental ingredients in the design of such a dwelling even now have little currency amongst those concerned with building and equipping the all-electric house, so I make no excuse for further emphasis of these points.

With a basically storage space heating system, structural insulation to a standard of U.15 or better, double glazing, low air infiltration, and controllable ventilation are essential for comfort with economy. This can all be purchased at a price comparable with that of a present-day conventional dwelling equipped with fired central heating, and it enables acceptable running costs to be achieved, with the future trend of fuel costs favouring electricity. The argument for double glazing does not rest solely on economic considerations, particularly in modern living rooms where the proportion of glazed area to floor area is large, with a tendency for the glazing to be concentrated in one wall. With single glazing the effect on occupants is to subject them on one side to large radiation losses, which in cold weather may occasion real discomfort.

The use of a low-temperature storage system does not preclude the use of low-temperature skirting or panel heating. The two systems are in fact complementary, supplying "background" and "auxiliary" heating respectively. Temperature control by room thermostat is simple and accurate. Operation with lower floor slab temperatures is economical. Maximum demand is low; in my case with a 775 sq ft area ground floor, the floor warming maximum demand is 3 kW and the free standing plate/skirting demand is less than 2 kW.

It is not essential to disturb the floor surface in the unlikely event of having to repair an embedded cable, provided that loops on one side of the grid are taken into floor trunking. All that is necessary is to short-out the faulty turn thus putting up the total loading slightly.

Wickham, Hants. GEOFFREY LOMAX, A.M.I.E.E., A.M.I.Mech.E.

Tests on a Washer

A LETTER published in your journal dated 28th November was recently brought to my attention in which reference was made to the inadequacy of the B.L.R.A. standard soiling mixture.

May I state immediately that this is not the case and that the author is obviously misinformed on matters connected with the evaluation of washing performance and detergency. The standard soiling mixture is a formulation based upon a large number of analyses of natural soil and accurately reproduces the amount of fatty and particulate soiling matter present on worn articles of body linen, etc. It is a standard used throughout this country and in many other parts of the world, and it is one that enables an accurate assessment of soil removal under any desired condition of laundering.

The details of the tests carried out by the Consumer Research Association were not known to us but what can be stated with certainty is that the soiling mixture used is one that is universally approved and also one that can be adequately removed during a conventional laundry or domestic washing machine process.

Hendon, N.W.4. J. LEICESTER, *Director of Research*, British Launderers' Research Association.

[The letter referred to related to a solution employed by the Association for Consumer Research in a test on the "Merlin" sonic washer.—Editors, *Electrical Review*.]

Heat Transfer in Steam Condensers

DETAILS of an experimental investigation into the effects of cross flow with condensation of steam and steam-gas mixtures on a vertical tube were given by Dr. T. Furman (National Coal Board) and Mr. H. Hampson (Robert Gordon's Technical College, Aberdeen) at a recent meeting of the Institution of Mechanical Engineers. The much lower rate of heat-transfer coefficients with filmwise than with dropwise condensation was said to be due to the need to conduct the latent heat through a continuous condensate film. This effect was increased by the presence of non-condensable gas, which formed an additional layer of film. A "steam" funnel was described which gave approach velocities to the tube up to 150 ft/sec at about atmospheric pressure. For all gas concentrations used with filmwise condensation considerable improvement of overall coefficients was shown for cross-velocities up to about 50 ft/sec. With dropwise condensation significant improvement was also evident up to somewhat higher velocities.

Faulty Wiring and the Law

By F. E. SUGDEN

A CASE of interest to electrical contractors recently occupied the attention of the High Court. The defendants in the action were tenants of certain premises containing a number of offices let to sub-tenants. The plaintiff was employed by the landlord of the premises as caretaker.

The plaintiff agreed with the defendants' manager that the plaintiff would take over the defendants' offices and she consequently employed charwomen to do the cleaning in the early morning before the offices were opened for business. Thus the plaintiff in law was not an employee of the defendants as she was not subject to their control or direction.

Subsequently, in the absence of one of the charwomen, the plaintiff herself cleaned the defendants' offices. Whilst so engaged she noticed that an electric fire standing on the floor required cleaning and, while cleaning it with a duster, received very severe burns as a result of which the fingers of her right hand had to be amputated.

At the time of the accident, the fire was plugged into a wall socket controlled by the normal type of switch. The switch was in the "off" position and the fire was cold but nevertheless the element was alive. The result was that although it would appear to anyone looking at the fire that it was perfectly safe to clean, there was grave danger of shock.

The Judge found that there was no fault in the fire itself, but that the wiring from the main switch to the socket was faulty in that the socket switch was in the neutral wire and not the line wire.

When they entered upon the tenancy of the premises the defendants had taken the precaution of having the offices completely wired by electrical contractors. The Judge decided that owing to the negligence of one of the contractors' workmen the switch was dangerously wired. As the plaintiff was not a servant of the defendants but an "invitee," the defendants as "invitors" were bound to exercise due care for her safety. The defendants had done all in their power by engaging electrical contractors whom the Judge agreed were competent, but the contractors had employed an incompetent workman to execute the wiring.

The plaintiff failed to prove her case against the defendants. If the claim had been made in the first instance against the electrical contractor the contractor could not have successfully defended the action and the Judge stated that if the plaintiff had succeeded in the action the claim would have gone into thousands of pounds.

This case is a warning to electrical contractors that they should employ only capable and efficient workmen. Otherwise they stand a grave risk of incurring substantial damages. They may insure against this, but if too many claims are brought against them the insurance companies will raise their premiums or decline to accept the risk at all.

Electrical Safety in Industry

Analysis of Accidents in Factories and their Causes

THE publication of the Ministry of Labour and National Service entitled "Electrical Accidents and Their Causes" for 1957 is now available (H.M. Stationery Office, 5s). It records that the number of such accidents reportable under the Factories Acts (i.e. entailing three days' disablement) was 687, of which 32 (18 up to 250 V) were fatal, compared with 797 and 40 in 1956. In addition, 37 known fatalities occurred in other industrial or similar premises and 66 in domestic or similar premises, bringing the aggregate of fatalities up to 135 (144 in 1956). Of the 687 accidents, excluding eye flash from welding (160 cases), 171 (13 fatal) were caused by portable apparatus and cables.

The number of electrical accidents involving shock, with or without burns, was 291, while the number of accidents involving burns, with or without shock, was 365 and the number of accidents involving shock and burns together was 144. In the fatal cases (30) nine artificial respiration crews worked for over an hour to save their colleagues, but 14 crews broke off from efforts lasting from a few minutes to less than an hour. The report says it is distressing that they did not follow the well-known advice to persist for hours in the hope of saving life.

In 1957 there were only seven accidents, one of them fatal, from contact with overhead lines on premises subject to the Factories Acts, compared with 14 in 1956 of which six were fatal. The total known fatalities in 1957 were 14 compared with 20 in 1956.

APPARATUS INVOLVED IN REPORTABLE ACCIDENTS

Apparatus	Fatal	Non-Fatal
Portable and Transportable Apparatus		
Portable electric machines, etc.	9	50
Portable heaters and irons	1	3
Portable lamps	—	9
Portable testing sets, including lamps, instruments, etc.	—	28
Plugs, sockets and adaptors	—	30
Cables and flex for portables	2	23
Electric hand welding:		
Shock and/or burns	1	15
Eye-flash	—	160
Fixed Apparatus		
Electrical machines	—	8
Transformers and reactors	1	17
Switchgear above 650 volts:		
(a) Switchboards	4	23
(b) Motor or other control apparatus	2	1
Switchgear below 650 volts:		
(a) Switchboards	4	48
(b) Motor or other control apparatus	1	57
Fusegear	—	29
Crane and other trolley wires, etc.	2	23
Fixed lamps	1	14
Cables and accessories for fixed apparatus	1	76
Test leads, test terminals, etc.	1	20
Overhead transmission and distribution lines:		
(a) Contact by cranes or similar machines	—	—
(b) Direct contact by persons or materials and tools	1	6
Apparatus not classified	1	15
Total	32	655

UNDERGROUND HYDRO-ELECTRIC STATIONS

Above: Machine room of Verbano power station, Switzerland, showing the four 25 MW vertical Francis turbines. The transformer cells can be seen at the right-hand side. Right: The 475 ton rotor of a 100 MW ASEA generator at Harspranget power station

Among the advantages of underground power stations compared with surface stations are lower basic cost of construction, additional effective head, freedom from freezing and preservation of rural amenities. The author surveys present practice in the design of underground stations and the difference in the overall scheme compared with conventional hydro-electric projects

By B. K. R. PRASAD, D.Sc., M.I.E.E., M.Am.I.E.E.

THE earliest underground power stations were installed between 1899 and 1917, but after this only a few were built until the last war. Since 1945 a large number of stations of this type have been constructed in Europe, and a few in other parts of the world including South America, North Africa, Canada and the U.S.S.R. To-day, there are over 120 underground power plants, big and small. The head ranges from around 18ft to 3,500ft (Norway); the capacity from 30 kW to 2,800 MW (Australia); and the quantity of water used from 15 cusecs to about 14,200 cusecs (Harspranget, Sweden).

Such power stations have been built in all types of rock formation depending on the conditions in the different countries. Some are run-of-river plants, a large number are storage plants, some are base-load stations, others are peak-load stations, and a few are pumped storage schemes. Whatever difference there may be in the situation, size, layout or operation of underground stations, they represent the most economical solution as, basically, they cost less than the surface stations. If credit is given to the additional effective head obtained with underground stations, power production will also be at a lower cost.

Credit can also be given to the scenic effects, freedom from landslides, avalanches, freezing, etc., which are all semi-tangible benefits. In recent years improvements in tunnel-driving methods, advanced design of pressure shafts, and large plants, have improved the economics. But in countries where the cost of underground excavation is high, as in the U.S.A., it is less competitive, especially as it requires more labour and less material than surface power stations. In Europe, the U.S.S.R. and Asiatic countries, the adoption of more labour and less material is favourable. In Switzerland and Canada the cost for excavation for underground power stations is not much more than for surface stations in the same area.

The majority of underground stations which have been or are being built are in Europe. The total capacity will exceed several million h.p. Although these power stations are built mostly on economic considerations, they are proof against aerial bombing and if built deep enough they may be proof against atomic bombs. The cost of underground stations is on the average about 30 per cent less than that of conventional surface stations, mainly due to shorter developments, elimination of penstocks and some valves, savings in tunnel linings, operating and maintenance expenses, elimination of roofs, painting and, to some extent, heating. The depreciation charges are smaller. The major portion of the expenditure is on excavation.

In general, underground power schemes ought to be

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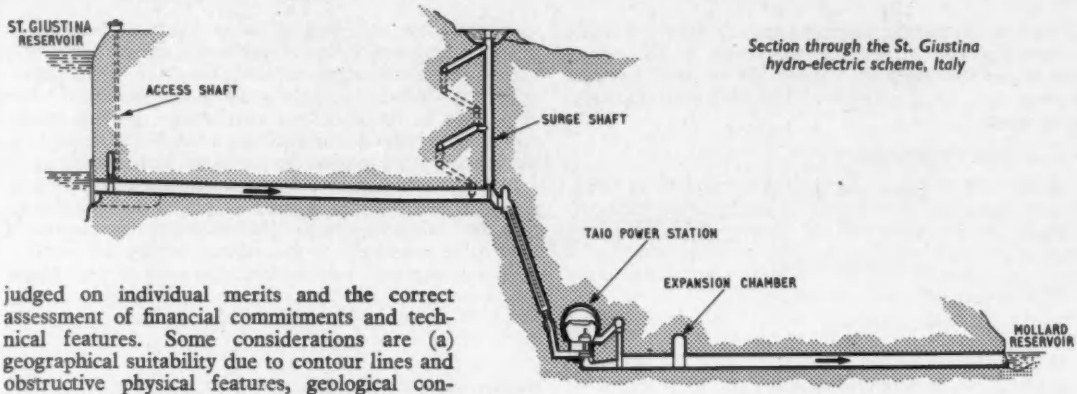
1. Machine room of Hol II power station, Norway. 2. Machine room of Isere Arc power station, France, showing the four 45,000 h.p. vertical Francis turbines which operate at a head of 500ft. 3. Fionnay power station, Western Switzerland, showing the two vertical Francis turbines (photo: Electro-Watt, Zurich). 4. The Taio power station machine room, Italy. 5. River being diverted into a vertical shaft during construction of the dam at Harspranget power station, Sweden

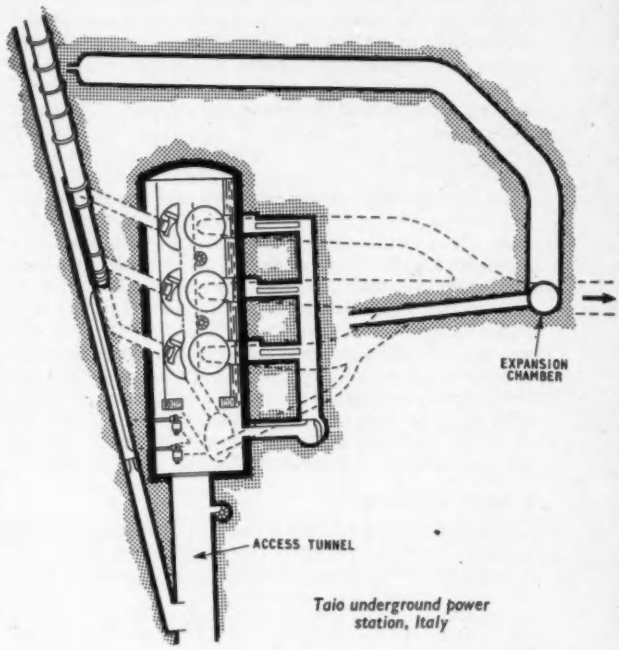


Section through the St. Giustina hydro-electric scheme, Italy

judged on individual merits and the correct assessment of financial commitments and technical features. Some considerations are (a) geographical suitability due to contour lines and obstructive physical features, geological conditions and absence of suitable facilities for conventional designs with surge tank, pipeline and surface generating station; (b) suitable climatic conditions, good average temperature underground and facilities to carry out work even in winter; (c) a large concentration of power is possible and there is flexibility in turbine governing; (d) a proper ratio of intake shaft length to turbine head can be effected.

Size of Excavation

The dimensions of underground power houses depend upon the size and number of generating units and station arrangement. Depending upon the head, turbines may be impulse (Pelton wheel) or reaction (Francis or Kaplan). Most of the installations adopt vertical design, but horizontal turbines are also used for high heads. Less space is occupied by vertical reaction wheels, the minimum width required ranging from 30 to 60ft. Provision has to be made for the space required for the travelling crane and for dismantling and repair areas. Transformers are arranged underground inside the general excavation for generators (Innertkirchen, Isere Arc) or in separate excavation parallel to the generators (Vinstra and Soverzene) or nearby (Harspranget). In some cases transformers are situated above ground. A general rule of thumb adopted in Italy states that if the length of the low-voltage transformer cables exceeds 250 to 300 metres, the placing of transformers underground is cheaper. The control valves for the turbines may be situated inside the main excavation or in a separate excavation upstream of the turbine room (high head schemes).



Taio underground power station, Italy

Turbine Hall

In general, the thickness of overburden above any power house excavation is prescribed to be twice the width of the excavation with a minimum overburden of 30 to 35ft. In some places (Clachan, Scotland) the power house was excavated by trench and cover method. For large power stations, where the rock strata are suitable, the longitudinal axis of the power house should be at an angle of 20 to 30 deg to the axis of the pressure shaft, as this is favourable for the design of distribution pipes. The walls may be double, with drainage in between and, if required, reinforced walls may be used. In some cases the rock is sprayed by the gunite process or concreted, or left in excavated condition as in Sweden. Sometimes, as in Soverzene, supports may be given for weak spots by reinforced concrete walls. Vertically arched or elliptical walls are also used (Italy and Sweden). A second wall leaving a space between the rock and the wall is quite commonly used with arrangements for air circulation in the space (U.S.S.R., Sweden and France). Crane beams are supported on columns which stand free away from the rock. In some cases, as in Sweden, the crane bridge extends over the stop log gate to enable the gate to be raised and lowered by the crane. The stop log may also be operated from a vent shaft from the transformer gallery.

The roofs may be semi-circular or elliptical and the walls vertical. The roof arch may support the full rock load in some cases and only 25 per cent in good rock. Stresses are reduced on the vertical faces if the roof arch abuts into the recess of the rock. In some cases, as in Sweden, reinforced inverted T-beams are used giving space between the rock and the roof. Usually, the roof is of monolithic concrete, placed against the rock and grouted with a second thin arch for waterproofing.

In some stations the turbine floor is reinforced to withstand full water pressure in case of breakdown of the pressure pipeline. Compartments are also provided for each turbine to take full hydrostatic load. Arrangements may be made to take tail race surge.

Instead of the usual concrete foundation block, the design sometimes includes a steel casing which supports

the waterwheel and the generator and, by suitably placing the bearings and the exciter, the height of the power station can be reduced. Some Swiss and Swedish methods are good examples: Innertkirchen, Fionnay, Harspranget.

Access and Ventilation

Access may be either horizontal, vertical or inclined. Usually, horizontal or inclined access tunnels are preferred and are cheaper than vertical shafts. Vertical access shafts are usually smaller and have to be provided with elevators. A track is usually provided in horizontal access tunnels for carrying heavy machinery.

Ventilation and generator and transformer cooling systems are important factors. Nowadays, closed-circuit cooling is adopted for the generators, using the tail water as coolant. Transformers are equipped with forced-oil forced-water cooling systems. For the ventilation of the power station, control room, etc., fresh air is taken from the surface and blown into the power house through the access shaft or gallery or through separate ventilating shafts. Arrangements may also be made for adequate air conditioning. In very cold countries, some of the hot air may be discharged into the intakes to prevent freezing of the water.

Architecture

In underground power stations good architectural treatment is possible. An arched roof is usually provided under the natural arch of the rock. The rock itself may be covered with concrete, but the thin reinforced arch roof below the rock will not only prevent broken rock and seepage water falling into the turbine hall, but also help drainage. The arched roof is also pleasing to the eye, and the space between this and the crane girder is well suited for indirect lighting. In Soverzene, there are decorative mural paintings on the roof and the sides which give a pleasing effect. The lighting of the side walls with opaque glass windows gives the effect of daylight and relieves the monotony for the operating staff.

Station Position

Underground power stations can be classified under two headings by their position, (a) head development and (b) tail race development. (a) This type eliminates surge tank chambers and long pressure tunnels. It permits quick opening and closing of turbines, eliminates penstock valves and permits an unlined tail race. The same operating staff can attend to the power house and the equipment at the dam and the intake. Usually, shaft elevators, vertical or inclined, are provided. There is a likelihood of the power station being inaccessible in a mountain area and the transmission lines longer. The tail race will be long and will have to be larger to take care of surge waves. Sometimes ventilating shafts have to be provided. If the tail race can be left unlined, head developments are economical in good rock. These are common in Sweden. (b) This type requires long, lined pressure tunnels, surge chamber and tail race, sometimes with surge enlargement. Access tunnels are shorter, communication to the power house is easier, cables to the surface are shorter, and some economy may be effected in transmission lines. Examples exist in Switzerland, Italy, Canada and India.

A comparison of costs made in 1948 for a surface development with 25,000ft inclined pressure tunnel, 1,000ft lined steel penstock, surface power house, and 2,000ft of lined tail race tunnel with an underground station having 500ft intake shaft, 1,000ft access shaft, and 29,000ft of unlined tail race tunnel, showed a saving of 43 per cent of the surface cost. In underground developments large, long tunnels are common, for example, about 26,000ft in Sweden, 35,000 to 60,000ft in Switzerland and Norway and even longer in Canada and Australia.

Intakes

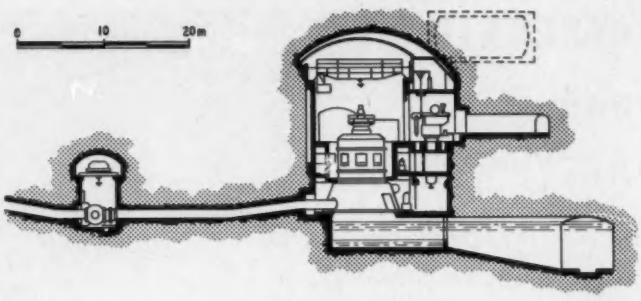
There is not much difference between conventional and underground station intakes except that the latter are deeper. Stop logs, Stoney gates or Tainter gates are used. Pressure tunnels are concrete lined, and pressure shafts are steel lined. Most pressure tunnels are circular or horse-shoe shaped, the lining depending upon the quality of the rock and hydraulic pressure. The water velocity is usually about 10 ft/sec. European tunnels have thinner linings than American tunnels. Pre-stressing gives some saving.

Surge chambers may be vertical or inclined, with lower and upper expansion chambers. The entire structure may be excavated in rock. The design of surge chambers is a very important item in tail race developments, especially with reference to the effects of water hammer in the pressure shafts. In some recent developments in Canada, India and Australia, elaborate studies have been made on surge chambers. Head developments may use separate pressure shafts for each turbine, whereas in tail race developments, one or two pressure shafts may be adequate and branch lines may be constructed near the power house. Pressure shafts may be uniform in diameter or stepped in size from the top to the bottom. Proper grouting methods may reduce lining and reinforcement. These shafts are designed to take full hydrostatic head. Nowadays, steel lining is

Machine room of Handeck II power station, Switzerland

being used, the thickness of the lining increasing from the top to the bottom.

Water control for head development may be by intake gates, and by single or double valves for tail developments. Operation of the gates and valves may be hydraulic, electric or controlled by governors. The valves may be in a separate chamber as is common in Swiss, Indian and Canadian developments; in a passage between conduit tunnel and power house, as in Sweden; or in the power house proper, as in Italy and France. Valves in a separate chamber reduce the width of the power house, but require a separate valve tunnel, separate crane, and access passage. Hence total excavation is larger.



Handeck II underground power station

The design of the tail race is important for the economic justification of the underground power house, especially in head developments. The slope should give a water velocity of about 6 to 8 ft/sec. The tail race tunnel may be:—(i) Free surface type during stabilised stationary flow or maximum surges; this requires a large cross-section but no surge shaft or enlargement. (ii) Free surface stabilised flow, but submerged during non-stationary flow and then to act as a pressure tunnel; this requires surge enlargement at the head of the tail race and should be designed for fluctuations in water quantity and not for stability of the fluctuations. (iii) The tail race acts as a pressure tunnel during non-stationary flow and requires a surge shaft and a ventilating shaft.

If the length of the tail race is 1,500ft to 2,000ft, the economical choice is a graded tunnel. For 7,000ft to 9,000ft, horizontal enlargement reduces rock excavation. For very large tunnels, surge shafts are the most economical. Model tests are advisable for determining the economic solution for non-stationary flow in tail race tunnels.

When the step-up transformers are installed underground, the high-voltage power is led to the switchgear above ground by means of cables, which may be either pressure oil filled or gas filled. Suitable gradients are adopted with pressure regulators at top and bottom, and in the intermediate positions. The cable tunnel may be inclined or nearly vertical according to convenience.

The switchgear is generally arranged on the basis of the unit system, i.e. one generator-transformer group for one line. Lightning arrestors for the busbars and outgoing lines are usually provided. In some cases, as in Grand Dixence and Innertkirchen (Swiss), the switchyard is placed in front of the cavern on level ground and all the connections are similar to a conventional power supply system.

Where long-distance transmission is adopted, carrier current protection is preferable, with some intermediate switching stations, as in Kemano (Canada), Koyna (India) and some plants in Europe and Australia. The receiving stations are generally connected with other networks. The required capacity of synchronous or static condensers should be provided.

There is a tendency at present to place small switching stations underground and, in the future, larger ones may also be underground, for military reasons.

ZIRCONIUM PRODUCTION

THE advent of large-scale nuclear power plants has created a demand for a material which can be used for parts operating within the reactor, such as canning, structural fittings, etc. The material requirements are a low neutron absorption, sufficient mechanical strength and good corrosion resistance. It has been discovered that zirconium and certain of its alloys are suitable materials but zirconium oxidises very readily and is easily contaminated by gases such as nitrogen and hydrogen. It must, therefore, be melted in furnaces that can be completely evacuated.

The vacuum melting plant of William Jessop & Sons, Ltd., Sheffield, which has been used successfully for the production of titanium alloys, is now being employed for the production of zirconium and its alloys. Raw zirconium sponge is compacted under pressure into solid briquettes. These compacts are welded together in an argon atmosphere to form an electrode. The welded electrode is then placed above a water-cooled copper crucible in the primary furnace, the whole assembly is evacuated and melting commences when an arc is struck between the zirconium electrode and a protective layer of zirconium sponge on the base of the copper crucible.

The heat generated by the arc melts away the electrode, and the molten metal gradually builds up a chilled ingot inside the water-cooled crucible. Melting continues until the electrode is completely consumed. The ingot so made is then used as the electrode in a secondary vacuum melting process. This secondary melting is adopted to ensure complete solution of all "particles," homogeneity of the ingot and the greatest possible removal of harmful gases.

The secondary ingot is dressed by machining and is then ready for forging into bloom material from which the whole range of Jessop zirconium products are produced. The normal Jessop zirconium ingot will weigh about 800 lb though larger ingots may be available at a later stage of production.

Hospital Vacuum Cleaners

SAFETY in use and fitness for purpose are the predominant themes of the recently published B.S. 3028 : 1958 which deals with electric vacuum cleaners for hospital use. Three types of cleaner are covered: earthed, double-insulated and all-insulated. There are necessarily many type tests and for the first time in a British Standard for vacuum cleaners, a suction test is specified.

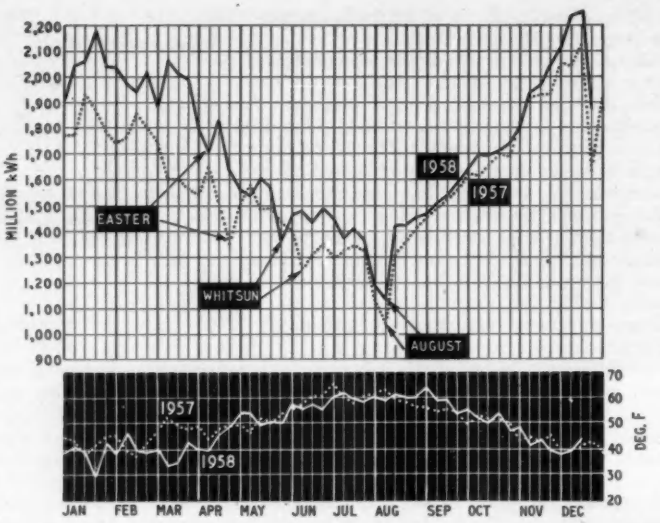
An endurance test requires the cleaner to be operated for two periods of 48 hr at specified voltages, and then to be started 50 times at one specified voltage and 50 times at another, after which "no deterioration shall have occurred which would impair the safe and normal use of the cleaner." Another of the Standard's many test requirements is that, with hoses and extension tubes coupled in accordance with the maker's instructions, a pull on them of 10 lb, applied for one minute, shall not cause them to become uncoupled.

Copies of this standard may be obtained from the British Standards Institution, 2, Park Street, W.1, price 7s 6d.

GENERATION and DEVELOPMENT

Steam Station Output

A week-by-week comparison of electricity output from steam stations in this country is given in the accompanying graph. Curves are also included showing the weekly average temperatures; for the whole of 1958 the level was about 1 deg lower than in the previous year. The aggregate output for the 52 weeks ended 26th December last was 90,013 million kWh, compared with 82,980 million in the corresponding period of 1957, an increase of 8·5 per cent.



Weekly output of steam power stations and average temperatures prevailing during 1957 and 1958

Service Centre Sales Expand

In a statement on the progress of the Merseyside and North Wales Electricity Board in 1958, the chairman of the Board, Mr. D. H. Kendon, says that the number of kWh supplied—nearly 5,000 million—represents a 7·5 per cent increase over the total for 1957. Industry is still the largest consumer, taking 2,750 million kWh, or 55 per cent of the total sales and 4·2 per cent more than in 1957.

One of the notable increases has been in the sales of appliances and equipment at the electricity service centres. Just over £2 million worth of electrical appliances were sold, 9 per cent more than during the previous year. The number of cookers sold rose from 17,000 to 19,000 and water heaters from 13,000 to 17,500. These new cookers and water heaters represent the sale of an additional 50 million kWh each year.

East Midlands Tariff Changes

The East Midlands Electricity Board has published details of variations in industrial and certain commercial tariffs which are to take effect from the end of March next. It is pointed out that these follow closely the alterations in the bulk supply tariff and although there may be changes in the amounts paid by individual consumers the Board is not budgeting for any increased revenue from the classes of consumer concerned. The principal changes are as follows:—

Industrial Tariff "A".—Maximum demand charges raised from 12s 6d to 14s 3d for each of the first 200 kVA of monthly m.d.; 11s 6d to 13s for each of the next 300 kVA; 10s 6d to 12s for each of the next 500 kVA; and from 9s 6d to 11s 3d for each additional kVA. "Unit" charge decreased from 0·69d to 0·63d for first 200 kWh per month per kVA of m.d.; from 0·66d to 0·56d for next 200 kWh; and from 0·63d to 0·50d for additional consumption. Fuel cost variation figure decreased from 0·00065d to 0·00059d/kWh for each 1d by which the fuel cost is more or less than 60s/ton. As an alternative to the above tariff an annual maximum demand tariff ("AA") will be offered. A fixed charge of 5d per month per kVA of authorised maximum demand is being introduced where the Board has provided the substation apparatus up to the terminals on the secondary side of the transformers.

Industrial Tariff "B".—M.d. charge per month is raised from 13s 6d to 15s 3d per kVA. "Unit" charge lowered from 0·75d to 0·67d for first 200 kWh per kVA of monthly m.d.; from 0·72d to 0·60d for next 200 kWh; and from 0·69d to 0·54d for additional consumption. Fuel clause figure changed from 0·0007d to 0·00063d. An alternative annual maximum demand tariff ("BA") is introduced.

Industrial Tariff "C".—Price per kWh for first 3,000 kWh per quarter raised from 2·50d to 2·60d; for next 3,000 kWh from 2·25d to 2·35d; and for additional consumption from 1·75d to 1·85d.

Commercial and Miscellaneous Tariffs.—Tariff 1.—Maximum demand charge each quarter increased from £6 to £6 10s for first 2 kVA of annual maximum demand; from £3 to £3 5s for each of the next 18 kVA; from £2 10s to £2 12s 6d for each of the next 30 kVA; and from £2 to £2 2s 6d for each additional kVA. "Unit" charge lowered from 0·75d to 0·67d for first 600 kWh per kVA of quarterly maximum demand; from 0·72d to 0·60d for next 600 kWh; and from 0·69d to 0·54d for additional consumption. Fuel cost variation figure reduced from 0·0007d to 0·00063d. Tariff 3.—Price per kWh increased from 1·75d to 1·85d.

Mr. B. T. Flanagan, chairman of the Hong Kong Electric Co., Ltd., opening the new North Point "B" power station (see "Electrical Review," 2nd January, page 16). With Mr. Flanagan in the photograph are (left to right) Mr. G. M. Goldsack, the Hon. Sir Tsun Nin Chau, Mr. W. Stoker (general manager), the Hon. D. M. Barton and Mr. J. F. Barrow (deputy manager), directors of the company

OVERSEAS

New Zealand Power Projects

Implementation of the New Zealand Government's newly-declared policy regarding Waikato power projects will not be long delayed. Mr. J. H. Macky, chief engineer on the Waikato, said that the new 180 MW station at

Maraetai, excavation work for which had just begun, would be situated about 600ft downstream from the existing Maraetai dam. It would be a peak load station, using water banked up behind the existing dam and piped through a tunnel from Lake Maraetai. Mr. Macky said that three months' drilling still had to be done at Aratiatia before the engineers could be sure of the exact form the project would take. An investigation shaft would be sunk this month to check information obtained from the drill holes along the banks of the river. This 60 MW project would use water diverted around the rapids by a 1,800ft tunnel.

Oaky River hydro-electric station. Right: G.E.C. alternator and Boving turbine showing the 4¼ ton disc flywheel between the alternator and Pelton wheel

Improved Results in N.S.W.

Average fuel costs per kWh sent out by the N.S.W. Electricity Commission last year decreased by 13½ per cent. Greater output of power from the new stations on the coalfields—Tallawarra, Wangi and Wallerawang—contributed to this decrease. Sales of electricity rose by 12·9 per cent and the average selling price fell from 1·805d in 1956-57 to 1·762d in 1957-58. The Commission produced more than 95 per cent of its electricity from coal, and consumed 3,400,000 tons of coal during the year. The three collieries owned by the Commission provided more than 25 per cent of its total coal requirements. New generating plant with a capacity of 139 MW and 560 miles of new transmission lines were placed in service. The year's operations closed with a comparatively small surplus of £89,573 from an income of £43 million.

Oaky River Hydro Scheme

A second generating set was commissioned during 1958 at the Oaky River hydro-electric station some 380 miles north of Sydney, New South Wales. The power station contains two overhung single Pelton wheels direct coupled to alternators running at 600 r.p.m. One machine has an output of 3,125 kVA and the other 3,450 kVA.

The alternator of the larger set was made by the General Electric Co., Ltd., and has a cylindrical rotor hub to which the poles are secured. It is designed to withstand an overspeed test of 1,100 r.p.m. Both the machines generate at 11 kV, three-phase, 50 c/s which is transformed to 66 kV and transmitted to the load centre 32 miles away.

Normally the plant is operated under fully automatic control from the operator's cottage situated at the top of the gorge. A steep railed track 2,200ft long is the only means of access to the power station.

New Generating Plant

DURING 1958 the Central Electricity Generating Board installed new generating plant giving an additional output capacity of 1,154 MW. This total is smaller than in recent years but conforms with the programme planned five years ago. This took into account plant outstanding from earlier years and also the decision of the Government in 1953 to give priority to export orders for power station plant.

Altogether 19 turbo-alternators, with an aggregate installed capacity of 1,230 MW, and 17 boilers, with an aggregate evaporative capacity of 9,100 klb/hr, were installed in 16 power stations belonging to the Board in England and Wales, two of which were new stations.

Four of the 17 new boilers, having an aggregate capacity of 2,190 klb/hr, were oil fired. At seven existing stations a further 28 boilers, with an aggregate evaporative capacity of 11,200 klb/hr, were converted from coal to oil firing during last year.

The first of a number of 120 MW turbo-alternators planned for commissioning in the next few years, was brought into service at Blyth "A" power station on the north-east coast. This is the largest unit yet installed by the Board. The boiler associated with this unit has an evaporative capacity of 860 klb/hr and provides steam for the turbine at a pressure of 1,500 p.s.i. and a temperature of 1,000 deg F with reheat to 1,000 deg F.

PLANT COMMISSIONED BY THE C.E.G.B. IN 1958

Name of Station	Project Group	Turbo-Alternator Plant		Boiler Plant		Main H.P. Pipework
		Installed Capacity MW	Makers	Capacity klb/hr	Makers	Makers
Steam Plant						
Acton Lane "B" ...	Southern	1 × 30	Richardsons, Westgarth	1 × 240	Mitchell Engineering	Aiton
Blyth "A"*	Northern	1 × 120	Metropolitan-Vickers	1 × 860	Babcock & Wilcox	Babcock & Wilcox
Bold "A"	Northern	1 × 30	Metropolitan-Vickers	—	—	Aiton
Bold "B"*	Northern	1 × 60	General Electric Co.	1 × 550	John Thompson	Aiton
Brighton "B" ...	Southern	1 × 60	Richardsons, Westgarth	1 × 320	Babcock & Wilcox	C. A. Parsons
Castle Donington ...	Midlands	1 × 100	Metropolitan-Vickers	1 × 830	Babcock & Wilcox	Aiton
Ferrybridge "B" ...	Northern	1 × 100	C. A. Parsons	1 × 760	Stirling Boiler/ Babcock & Wilcox	Stewarts & Lloyds
Goldington	Southern	1 × 30	British Thomson-Houston	1 × 300	Clarke Chapman	Stewarts & Lloyds
Hams Hall "C" ...	Midlands	1 × 60	General Electric Co.	1 × 550	Simon-Carves	Stewarts & Lloyds
Hayle	Southern	1 × 20	British Thomson-Houston	1 × 200	Yarrow	Stewarts & Lloyds
Marchwood	Southern	2 × 60	English Electric Co.	2 × 550	John Thompson	Stewarts & Lloyds
Poole	Southern	2 × 60	General Electric Co.	1 × 340	International Combustion	Aiton
Portishead "B"* ...	Southern	1 × 60	Metropolitan-Vickers	1 × 300	Mitchell Engineering	Stewarts & Lloyds
South Denes	Southern	1 × 60	Metropolitan-Vickers	1 × 550	International Combustion	Stewarts & Lloyds
Tilbury "A"	Southern	1 × 60	C. A. Parsons	1 × 540	John Thompson	John Thompson
Willington "A" ...	Midlands	2 × 100	English Electric Co.	2 × 830	International Combustion	Aiton
16 Stations including 2 New Stations	3 Project Groups	Totals 19 and 1,230 MW		Totals 17 and 9,100 klb/hr		

* Stations in which plant was commissioned for the first time.

NEW ELECTRICAL EQUIPMENT

Potentiometer Spindle Nut

Polythene nuts which screw on to a potentiometer fixing bush to prevent the spindle rotating and varying the

Girdlestone Pumps potentiometer nut

setting of the potentiometer have been announced by the H.F. Components Division of GIRDLESTONE PUMPS, LTD., 23, Davies Street, London, W.1. A clearance hole enables the nut to grip the standard ¼in diameter spindle sufficiently firmly to check any tendency to rotate, while allowing adjustment by screwdriver.

To prevent unauthorised adjustments being made, a dome headed protective cover is available which can be fitted to the nut concealing the spindle end. To assist in identification or coding when a large number of potentiometers is installed the nuts and covers are produced in seven distinctive colours.

Nyquist Diagram Plotter

An automatic machine for testing most servo-mechanisms at present produced has been announced by SERVO CONSULTANTS, LTD., 17, Woodfield Road, London, W.9. A signal produced by an electro-mechanical frequency generator is applied to the system under test. The return signal is received by the plotter and, after amplification, is applied to two servo-mechanisms operating a printing head. One is a phase detector which measures the phase angle between the outgoing and the incoming test signals, and the other indicates the incoming signal amplitude. The plot is obtained in the form of a number of easily identified definite frequency markers. The instrument can be used with a.c. and d.c. systems and also hydraulic or pneumatic systems, a mechanical coupling being made to the output shaft of the generator incorporated in the plotter. The overall dimensions of the instrument, which is intended for bench operation, are 27in by 25in by 20in, and the weight is approximately 150 lb.

Centrifugal Blower

The type PM.1C blower announced by R. B. PULLIN & CO., LTD., Phœnix Works, Great West Road, Brentford, Middlesex, incorporating a permanent magnet d.c. motor and a moulded-case centrifugal impeller unit, delivers approximately 15 cu ft of air per minute against a back pressure of 0·7in water gauge. Less than 0·5 A

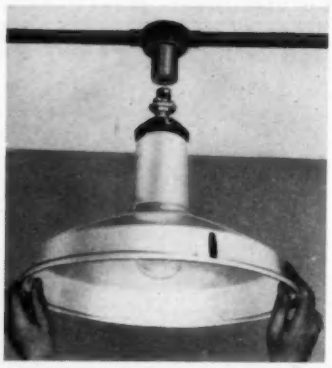
Pullin centrifugal blower

at 24 V d.c. is required and a continuous operating life of well over 1,000 hours is claimed. The approximate overall dimensions are, length 3·2in, width across moulded case 3·25in and depth of impeller case 1·2in.

Lighting Accessory

With the aid of a new lighting accessory manufactured by the SIMPLEX ELECTRIC CO., LTD., Blythe Bridge, near Stoke-on-Trent, Staffs., industrial lighting reflectors can be converted into self-contained plug-in units, which may be connected or disconnected at will without disturbance of the wiring or lamps. The device, known as the "Discon," is in two main parts, the socket portion and the plug portion. In use the socket section is wired to the mains supply in the overhead conduit system and screwed on to the conduit box. Earthing is automatic but an earthing terminal is provided to meet special circumstances.

The plug-in section is attached to the reflector, the necessary connections having, of course, first been made. The reflector may now be instantly attached or detached from the conduit system, without disturbing lampholder, wiring or the lamp. The plug contacts



A reflector fitted with the Simplex "Discon" fitting and with lamp in position being plugged into an overhead conduit system

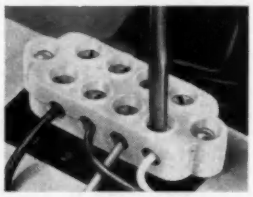
are silver plated and of adequate area to carry 15 A. The fitting will fit all Simplex dispersive and parabolic angle reflectors and the price is 15s.

Fluorescent Lighting "Pack"

A new 8ft 125 W "Popular Pack" fluorescent fitting has been introduced by ATLAS LIGHTING, LTD., 233, Shaftesbury Avenue, London, W.C.2. The fitting, which is equipped with an Atlas G.P. "Quickstart" white tube, is priced at £8 10s and is available for 230/240 V operation. The tube and lampholder are of the bi-pin type. The catalogue number of the fitting is H.D.0125.

Self-Locking Connector

A connector block, manufactured by the Cam-Block Division of the Willor Manufacturing Corporation of New York, incorporating a cam in the form of a rotary V-block to lock the conductors, is available in this country from INTERNATIONAL ENGINEERING CONCESSIONAIRES, LTD., 39, Parliament Street, Westminster, London, S.W.1. The block housing is manu-



Cam-Block connector

factured from plastic material capable of operating in temperatures up to 225 deg F, and nickel plated heavy gauge brass has been used for current carrying parts. The blocks can withstand 2,000 V between terminals and 3,000 V between terminals and base, and are available in sizes accepting from two to twenty conductors. Connectors rated for 15, 20 and 30 A can be supplied with a colour coding of white, black and red, accommodating wires from 0·01 to 0·94in in diameter.

Multiplier Phototube

A multiplier phototube, RCA-7265, with a broad response range, high sensitivity, low thermionic dark current, and high conductivity at low temperatures has been announced by RCA GREAT BRITAIN, LTD., Lincoln Way, Windmill Road, Sunbury-on-Thames, Middlesex. The 14-stage high current amplification type unit is suitable for use in scintillation counters detecting and measuring nuclear radiation, and in such applications as flying-spot scanning and

photometry which require low dark current as well as high sensitivity over the entire visible spectrum.

The spectral response covers a range from 3,000 to 7,500 angstroms, with maximum response at approximately 4,200 angstroms, extending beyond the visible spectrum into the blue and red regions. Electrostatically focused dynode stages utilising dynodes having stable high-current capability are incorporated, and focusing and accelerating electrodes have external connections. The 7265 phototube, which has a pulse-height resolution of about 8 per cent, has a flat faceplate, a minimum photocathode diameter of 1·68in, and a maximum length of 7½in.

Remote Control Equipment

A range of remote control stations, each consisting of a number of standard units, has been introduced by DEWHURST & PARTNER, LTD., Inverness Works, Hounslow, Middlesex. Four basic control boxes are available in the "Dupar" range, providing general purpose and oil-tight types for surface or flush mounting. They are supplied in various sizes to accommodate up to 18 push-buttons. General purpose and oil-tight pushbuttons, indicator lamps and knob or key switches with four or six terminals and silver contacts can be supplied, and nineteen, coloured, scratch and stain resistant, laminated plastic faceplates with a satin silver or black bezel are among the finishes available.

Combined Washing Machine and Dryer

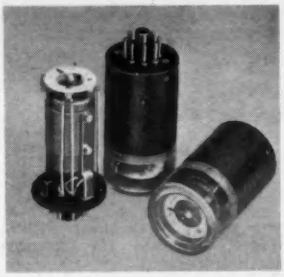
A combined washing machine, rinser and spin dryer, the "Jetmatic," has been introduced into this country by the CONTINENTAL WASHING MACHINE CO., LTD., 63, Great Eastern Street, London, E.C.2. It is claimed that up to 10 lb of clothes can be washed, rinsed and dried in the machine within eight minutes. A powerful jet action washes the clothes with a circulatory, tumbling movement—no agitator or pulsator being used. Rinsing is carried out in the spin dryer by means of cascade water jets fitted under the rim of the compartment. The speed of the spin dryer drum is 1,800 r.p.m.

The washing section of the machine is fitted with a 2 kW heating element. There is also an automatic pump which can be used for either filling or emptying the tub with water. The "Jetmatic" measures 33in high by 13in wide by 22in deep and the finish is in white vitreous enamel. Both wheels and rollers are provided for ease of manœuvrability. It is guaranteed for 12 months and the price, including purchase tax, is £88 4s.

Precision Relays

Designed and developed by Brion Leroux & Cie of Paris, relays incorporating a spring suspension moving coil unit are now available in this country from LELAND INSTRUMENTS, LTD., 22-23, Millbank, Westminster, London, S.W.1. The relays comprise a galvanometer movement, complete with scale and pointer, to which has been added a moving contact, and on each side of this two contacts are arranged beneath a transparent plastic dust cover, adjustable over the full scale range.

Sixteen fully shielded models are available, with moving coil resistances ranging from 2·5 to 7,500 ohms, and with full scale deflection current ratings ranging from 10 mA down to 0·02 mA. The minimum change of control power necessary to make or break contact in the most sensitive model is approximately 0·05 microwatt. Each model is available either as a maximum-minimum indicator with scale covering 90 deg and calibrated 0-100 divisions, or in centre-zero form with scale calibrated 50-0-50 divisions.



Leland Leroux relays

Dielectric Heater

The type RH65 6 kW heater for non-conductive materials has been added to the range of dielectric heaters manufactured by REDIFON, LTD., Broomhill Road, London, S.W.18. It consists of power and oscillator units, with a separate remote control unit if required. The heater operates from a 350-460 V three-phase, 50 c/s supply, with a consumption rising from 1·95 kW on standby to 11·25 kW at full load, when the power factor is 0·9. The tuning arrangements and electrode system supplied by the oscillator, which produces an output at 36 Mc/s, are designed specially for each application.

The overall dimensions of the power unit are 27in by 27½in by 33½in high, the oscillator unit 22in by 18½in by 21in high and the remote control unit 27in by 6½in by 6½in high, with weights of 637 lb, 90 lb and 15 lb respectively. All units have a standard two-tone grey dimple hammered finish.

Redifon heater and remote control unit

"Jetmatic" combined washing machine and dryer

Financial Section

STOCKS and SHARES

INDUSTRIAL markets of the Stock Exchange celebrated the first week of the new year with a fresh burst of strength which carried the share price index to the highest level ever recorded. At this point a good deal of profit-taking took place, with the result that some irregularity appeared and a number of popular issues gave up a part of their latest advances. The gilt-edged market has been in much better heart since the introduction of the new sterling convertibility arrangements. In the electrical engineering sectors, the English Electric Company's new capital issues are the centre of interest, while cable manufacturing shares have continued to attract attention.

English Electric Issues

Rather more than £10 million fresh capital is to be raised by the English Electric Company's two issues, of which the £6 million 5½ per cent debenture stock 1979–84 is offered to all classes of stockholders at a price of 97, and 1·83 million new £1 ordinary shares to existing shareholders at 50s per share, in the proportion of one new for every ten shares held. The extra capital is needed to finance increasing business. Orders in hand last month were almost one-third larger than they had been two years previously and turnover has expanded at a rate faster than the estimates. Bank loans have risen to over £20 million and are to be reduced out of the proceeds of the issues. Prices of the two new stocks are the same as on the occasion of the similar, but larger, capital operation in May, 1957. The 5½ per cent debenture stock 1977–82 created then has been quoted lately at about 98½.

Dividend Prospects

In his statement accompanying the offer, the chairman expects that profits in 1958 will have been not less than the £8·3 million earned in the previous year. He anticipates the maintenance of the ordinary dividend for 1958 on the present capital at the same total (14 per cent) as before, and that it will be possible to repeat this distribution subsequently on the increased capital. Following the announcements, the price of the existing ordinary shares hardened to 61s 3d, and on the distribution of the allotment letters they were called 59s ex-rights, with the new shares at a premium of 9s 6d on the issue price of 50s. At this level the prospective yield works out at 4¾ per cent. Shareholders are told that there is still a tendency for production costs to rise and for profit margins to contract, but that the future is viewed with confidence.

Higher Prices

Persistently heavy buying, much of it apparently of American origin, of Electric & Musical Industries shares lifted the price by another 8s 9d to 61s 3d; they have now practically trebled in value within twelve months. C. A. Parsons rose 2s 6d, to 55s, while there were gains of 3s or more in Reyrolle, at 97s 6d, International

Price Changes in

Company or Board	Nom. Value	Middle price 5th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1958 Highest	1958 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	77½	+½	3	3	3 17 6	77	72
Brit. Elec. 1974/77	100	74½	+1	3	3	4 0 6	73½	68½
Brit. Elec. 1976/79	100	78	+1	3½	3½	4 9 9	78½	72
Brit. Elec. 1974/79	100	88½	+1	4½	4½	4 16 0	87½	82½
Overseas Electric Supply								
Calcutta Elec.	£1	17/-		6·8†	7†	14 5 0	17/6	15/-
East African Power	£1	22/6	−6d	7½	8	7 2 3	23/-	17/6
Nigerian Elec.	£1	14/-		10	10	14 5 6	17/-	12/6
Perak Hydro-Elec.	£1	13/6		12½	10	14 16 3	15/6	13/6
Electrical Shares								
Aberdare Holdings	5/-	15/9		17½	17½	5 11 0	15/9	9/9
Aerialite	1/-	8/3		51½	54	6 11 0	8/6	5/1
Allen, W. H.	£1	43/9		10	11	5 0 6	43/9	32/9
Anglo-Portuguese Tel.	£1	27/3		8	9	6 12 0	29/3	19/9
Aron Elec. Ord.	£1	61/3		15	15	4 18 0	61/3	53/-
Assoc. Elec. Ord.	£1	57/6	+1/3	15	15	5 4 3	58/9	46/6
Automatic Tel. & El.	£1	80/-	+5/-	17	17	4 5 0	75/-	57/-
Babcock & Wilcox	£1	50/6		15	13‡	5 3 0	54/6	41/9
Bakelite	10/-	21/9	+6d	15	15	6 18 0	23/-	17/6
Baldwin, H. J.	2/-	2/9	+3d	20	20	—	3/9	2/6
Berry's Electric	5/-	11/-		10	10	4 11 0	11/3	5/9
Bowthorpe Holdings	2/-	12/6	+9d	37½	25*	4 0 0	11/9	6/6
British Aluminium	£1	82/6	+4/3	12	12	—	78/3	37/-
British Elec. Traction: Def. Ord. "A"	5/-	37/-	−1/-	25	25	3 7 6	40/-	19/6
B.I. Callender's	£1	51/6	−6d	12½	12½	4 17 0	52/-	38/9
B.I. Callender's 6% Pref.	£1	20/-		6	6	6 0 0	20/3	19/-
British Tabulating	£1	60/9	+9d	9	10	2 12 9*	60/-	30/9
British Thermostat	5/-	37/6	+1/3	25	30	4 0 0	36/3	19/9
British Vac. Cleaner	5/-	4/6		10	10	5 17 9*	4/6	2/3
Brook Motors	10/-	47/6	+2/6	25	24¼*	5 2 0	45/-	27/9
Bulgin, A. F.	1/-	7/-		40	45	6 8 6	7/-	4/7
Bulpitts	5/-	10/9	−3d	—	12½‡	5 16 3	11/-	7/3
Burco Dean	5/-	12/9x.d.	+6d	22½	16*	6 5 6	12/6	7/9
Cable & Wireless: Ord.	5/-	13/9	+1/3	10	10‡*	3 12 9	13/-	8/-
4% Loan	100	94		4	4	4 5 0	94½	89
Chloride El. Storage "A"	£1	70/-	+1/3	17½	17½	5 0 0	68/9	55/6
Clarke Chapman	£1	62/-		27½	27½	4 8 9*	72/6	55/-
Cole, E. K.	5/-	20/-	+3/-	17½	17½	4 7 6	18/-	15/3
Cossor, A. C.	5/-	7/-	−9d	2½	Nil	Nil	7/9	4/4
Crabtree	10/-	31/-		20	20	6 9 0	32/-	24/4
Crompton Parkinson	5/-	13/9		16	12*	4 7 3	13/9	8/3
Davis & Timmins	5/-	15/-		22½	18	6 0 0	16/3	10/3
De La Rue	10/-	32/9	+9d	35	17½*	5 6 9	34/-	20/9
Decca "A"	4/-	37/-	−6d	43¾	43¾	4 14 6	37/6	21/3
Desoutter	5/-	19/9	+6d	32½	18¾*	4 15 0	19/3	13/6
Dewhurst	2/-	8/3		20	20	4 17 0	9/3	6/9
Dictograph Tel.	2/-	7/6	+6d	20	20	5 6 9	7/3	4/7
Dubilier Condenser	1/-	3/6		30	20*	5 14 3	4/3	3/1
Duport	5/-	10/3	+3d	25	12½*	6 2 0	10/9	7/9
E.M.I.	10/-	61/3	+8/9	15	20*‡	3 5 3	52/6	20/9
Electrical Components	5/-	10/9		12½	12½	5 16 3	10/9	7/-
Elec. Construction	£1	30/-	+1/3	8½	8½	5 13 3	28/9	21/-
Elliott-Automation	5/-	18/3	+9d	—	10‡	2 14 9	19/9	11/6
Enfield Cable Ord.	£1	18/9	+2/9	Nil	2½	2 13 3	18/9	10/9
English Electric	£1	59/-x.r.		14	14	4 15 0	60/-	44/-
English Electric 3½% Pref.	£1	12/6		3½	3½	6 0 0	12/6	11/9
Ericsson Tel.	5/-	26/9	+6d	22†	12*‡	3 17 6	26/3	17/6
Ever Ready	5/-	22/3		37½	20*	4 10 0	22/3	13/9
Falk Stadelmann	£1	43/9	+1/3	17½	15	6 17 3	46/3	35/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

Combustion, at 30s 9d, and E. K. Cole, at 20s. Automatic Telephone were prominent with an advance of 5s to 80s. British Tabulating continued on their upward way from 60s to 64s before reacting to 60s 9d. Gains of 1s more were marked in Midland Electric, Chloride Electrical and British Thermostat, while among lower priced shares some of the best gains were shown by Bowthorpe, Switchgear & Cowans, Rheostatic, and Cable & Wireless. A huge turnover in the shares of British Aluminium and Tube Investments shares accompanied developments in the battle for control of the former company.

Electrical Investments

Company or Board	Nom. Value	Middle price 5th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1958 Highest	1958 Lowest
Electrical Shares—continued								
G.E.C.	£1	39/-	−1/-	12½	10	5 2 6	40/-	29/3
G.E.C. 6½% Pref.	£1	21/-		6½	6½	6 3 9	21/6	20/3
General Cables	5/-	8/9		24	15	8 11 6	11/9	8/3
Greenwood & Batley	£1	57/6		17½	20	6 19 3	57/6	45/-
Hackbridge Holdings	5/-	15/3		20	20	6 11 3	15/3	7/6
Hackbridge & Hewittic	5/-	14/-	+6d	20	20	7 2 9	14/6	9/7
Head Wrightson	5/-	25/3	+6d	22½	17½*	3 9 3	26/-	16/9
Heatrae	2/-	7/9		15	20	5 3 3	7/9	4/-
Holophane	5/-	15/6		37½	22½*	7 5 3	15/6	12/6
Hoover	5/-	58/6		50	50	4 5 6	58/6	31/-
I.C.I.	£1	36/9	−9d	10	12	4 7 3*	37/6.	23/9
Intl. Combustion	5/-	30/9	+3/3	22½	25	4 1 3	28/3	19/3
Johnson & Phillips	£1	28/3	+5/3	10	5	3 10 9	25/-	15/-
Lancashire Dynamo	£1	45/-		11	11	4 17 9	45/-	28/6
Laurence Scott	5/-	16/9	+6d	15	15	4 9 6	16/9	12/6
Lister, R. A.	£1	34/-x.d.		10	12½	7 7 0	34/6	23/-
London Elec. Wire	£1	73/9	+2/6	12½	12½	—	72/-	39/6
Lucas, J.	£1	44/9		7½	10‡	4 9 6	45/-	27/9
Marconi Marine	£1	41/3	+1/3	10	10	4 17 0	40/-	29/-
Marryat & Scott	2/-	8/9		35	37½	4 5 9*	8/9	5/3
Mather & Platt	£1	50/-	+1/3	15	15	4 0 0*	50/6	29/6
Metal Industries	£1	43/-	+2/6	9	14	6 10 3	44/-	22/9
Midland Elec. Mfg.	£1	42/6	+1/3	12½	10*‡	4 14 3	41/3	26/6
Morphy-Richards	4/-	20/-		20	20	4 0 0	20/-	14/6
Murex	£1	45/9	−1/-	20	17½	7 13 0	59/3	46/9
Newman Ind.	2/-	2/9		10	10	7 5 6	2/9	2/3
Oldham & Son	1/-	2/9x.d.		17½	17½	6 7 3	3/-	2/3
Parsons, C. A.	£1	55/-	+2/6	8½	7½*	2 14 6	55/-	43/-
Plessey	10/-	72/6	+2/6	30	30	4 2 9	72/6	55/-
Pye	5/-	15/-		12½	12½	4 3 3	17/-	10/-
Pyrotenax	5/-	37/9	+9d	—	27½‡	3 12 9	37/-	27/6
Reyrolle	£1	97/6	+3/9	17½	17½	3 11 9	93/9	73/6
Rheostatic	4/-	9/6	+1/-	12½	12½	5 5 3	8/6	6/-
Richardsons Westgarth	10/-	14/3		16¾	8½*	5 17 0	15/9	13/-
Scottish Cables	4/-	13/9	+1/6	27½	27½	4 13 0*	12/3	7/-
Simon-Carves	5/-	31/3		20	25	4 0 0	31/3	22/6
Smith (England), S.	4/-	12/-		20	12½*‡	4 3 3	12/3	7/-
Southern Areas	£1	12/-		7½	Nil	Nil	13/9	9/3
Strand Elec.	5/-	8/9		15	15	8 11 6	9/3	4/9
Sturtevant	5/-	17/6		15†	15†	7 10 0	19/6	14/9
Sun Elec.	£1	61/9	+1/3	25	25	8 2 0	60/6	47/3
Switchgear & Cowans	5/-	10/6	+9d	25	22½	5 7 3*	9/9	4/6
Taylor Tunnicliff	5/-	18/3	+6d	15	17½	4 16 0	18/3	11/9
T.C.C.	10/-	39/-	+1/6	25	25	6 8 3	38/6	32/6
T.C. & M.	£1	36/-	−1/-	8½	8½‡	—	37/-	20/-
Telephone Mfg.	5/-	5/-	+3d	10	10	10 0 0	5/9	4/3
Telephone Rentals	5/-	14/9x.d.	+3d	12½	12½	—	14/6	9/9
Thompson (John)	5/-	24/6	+9d	25	25	5 2 0	27/-	23/-
Thorn Elec. "A"	5/-	25/-		17½	17½	3 10 0	25/-	17/-
Thornycroft	£1	22/6	−1/3	12½	7½	6 13 3	30/9	21/-
Tube Investments	£1	78/3	−3/-	15	17½	4 9 6	81/3	48/3
Vactric	5/-	32/6	+6d	25	25	3 17 0	—	—
Veritys	5/-	5/3		12½	2½	2 7 6	6/9	5/3
Walsall Conduits	4/-	18/3		20	22½	4 18 9	18/3	11/-
Ward & Goldstone	5/-	36/6	−6d	40	25*	3 8 6	37/-	23/6
Watford	2/-	8/-		25	25	5 0 0*	8/-	4/-
Westinghouse	£1	46/3	+1/3	18	10*	4 6 6	45/-	32/3
West, Allen	5/-	13/6	+3d	15	12½*	4 6 6‡	13/3	7/9
Wolf Electric	5/-	8/-	+3d	20	10*	6 5 0	9/-	6/9

Cable Shares

Of the shares directly concerned with the mergers which are being negotiated within the cable manufacturing industry, London Electric Wire added 2s 6d to the initial rise of 11s 3d induced by the terms of the share exchange proposed by A.E.I. They moved up to 73s 9d in sympathy with an improvement in the A.E.I. shares to 57s 6d. There were minor recessions in the shares of B.I.C.C. and Telegraph Construction, who are also engaged in share exchange proposals. These developments have excited interest in other cables shares, notably in Johnson & Phillips, which jumped another 5s 3d to 28s 3d (after being 30s), Scottish Cables, 1s 6d higher at 13s 9d, and Enfield Cables which put on 2s 9d to 18s 9d.

Brook Motors Prospect

Brook Motors 10s shares added half-a-crown to previous advances, reaching 47s 6d, after the appearance of the full report, in which the chairman's review tells shareholders of a gradual improvement in trading conditions during the first quarter of the current financial year. Competition grows keener, but continued expansion from all the subsidiary companies is expected, and the order book is in a satisfactory condition. Despite the recent scrip issue, the balance sheet continues to show reserves much in excess of the ordinary capital of which £865,000 is in issue and £1·3 million is authorised. If the dividend rate is adjusted strictly in proportion to last year's capital increase, the yield on the shares works out at a fraction over 5 per cent. Maintenance of the distribution at the full previous rate of 25 per cent would raise it to 5½ per cent. The dividend distribution is covered more than three times over on the basis of profits earned in 1957–58.

Avo

A persistent rise in the price of Avo Electric 5s shares in recent weeks has been attracting attention. In the course of not much more than a month, the price has moved up from 8s to nearly 10s and is now just about double the figure at which the shares were first introduced to the market eighteen months ago. At that time the prospectus contained a striking record of growth over a decade and the last annual report, covering the year to March, 1958, showed a continuation of the rise in profits to £85,000, after tax. This represented earnings of 59 per cent on the £250,000 ordinary capital and provided good cover for the dividend, which was raised to a total of 25 per cent. At the annual meeting last August, the chairman referred to plans for the extension of the premises to meet increasing demands on the company's productive capacity.

REPORTS and DIVIDENDS

The Plessey Co., Ltd.—The annual meeting was held on 30th December, Mr. A. G. Clark (chairman and managing director) presiding. In his statement, which had been previously circulated, Mr. Clark said that it had been their policy to absorb, in whole or in part, increases resulting from wage awards and this, together with a considerable development programme, accounted for the discrepancy between the profits of the past two years. To counter this they had devoted intensive effort towards improvement in productivity and the streamlining of their organisation, with encouraging results.

With regard to the development programme, the work of adding continuously to their overall product range was now bearing fruit and in a number of cases completely new products were in production and other development work proceeded. Dealing with the various groups, Mr. Clark said that in the electronics and equipment group the domestic equipment business made a poor start because of national policy, but the position was now considerably improved. The components group, which manufactured components for the electronic and electrical industries, suffered to some considerable extent earlier in the year from credit restriction, purchase tax and the rising cost of labour. At present, because of changed Government policy and manufacturing economies, the future appeared brighter. Semiconductors, Ltd., a company formed jointly with Philco of America, was now a going concern, manufacturing transistors to a very high standard. Plessey Nucleonics, Ltd., was now firmly established in the atomic field and had substantial orders, both home and overseas.

In export markets their operations were expanding profitably and progressively with the full support of the home divisions.

Burco Dean, Ltd.—The main figures in the accounts for the year ended 30th September last were given in our issue of 19th December. In his review of the year, which has been circulated with the report and accounts now issued, Mr. D. K. Ward (chairman) says that they persisted with their planned advertising programmes, particularly with a scheme for increased outlets for Burco products in the northern areas and a programme to establish the name "Dean" for the products of the gas division. This publicity resulted in a pronounced increase in public recognition of these brand names and also in increased sales, but these were much less than would have been achieved had hire-purchase been as unrestricted as it is now. In the electrical division, represented by Burco, it is expected that the factory extension mentioned in last year's report will be completed next spring and it will bring the factory area of Burco to 190,000 sq ft.

The end of the credit squeeze had an immediate and beneficial effect on the order book. They have already acted to provide more factory space and more modern machine tools. They were planning a further factory of 100,000 sq ft on a site adjacent to the Burco factory. The directors expect that this development will be financed out of the company's own resources, but Mr. Ward does not rule out the possibility that they will need to seek further capital by issue of shares to shareholders in order to finance the resulting expansion.

The British Aluminium Co., Ltd.—A further development in the bidding for the company's shares took place last week when a group of city institutions, including bankers, joined with the British Aluminium Co.'s bankers in advising rejection of the offer of Tube Investments, Ltd. The group is offering 82s in cash per £1 unit for up to half the stock owned by ordinary holders, but reserves the right to refuse tenders when acceptances exceed a maximum sum of £7 million in cash.

On Monday last it was announced that Tube Investments had sent a circular letter to stockholders informing them that Tube Investments had decided to increase its offer to one fully-paid £1 T.I. ordinary share, plus 88s (in lieu of 78s) in cash for every £2 of B.A. ordinary stock. It is stated that the stock will be purchased ex the 13½ per cent dividend conditionally proposed in respect of 1958. These improved terms will apply to all B.A. ordinary holders who have already accepted the T.I. offer.

The Sun Electrical Co., Ltd.—A scheme of arrangement is to be submitted to shareholders under which the issued ordinary capital would be increased by way of capitalisation of reserves, the £1 ordinary shares subdivided into 5s shares and the preference rights amended to conform with modern practice.

The Morgan Crucible Co., Ltd., has announced an interim dividend of 5 per cent (against 3¾ per cent). It is stated that the increase is intended primarily to achieve a more even distribution between the interim and final dividends.

Aberdare Cables Africa, Ltd., has declared an ordinary dividend at the rate of 7½ per cent in respect of the year ended 30th June last.

W. H. Allen, Sons & Co., Ltd., have declared an interim dividend of 2½ per cent (unchanged).

Veritys, Ltd., have been notified of the presentation by the Midland Bank, who are creditors, of a petition for the winding up of the company. Application is to be made today (Friday) for the appointment of a provisional receiver. The company has an issued capital of £180,000 in 5s ordinary units. The last published accounts, for 1957, showed a trading loss of £29,422 against a profit of £62,124 for 1956. At that time indebtedness to bankers was given as £54,000.

New Companies

Thermit Welding (Great Britain), Ltd.—Registered 9th December. Capital £50,000. To enter into an agreement made 9th September, 1958, between Murex, Ltd., Th. Goldschmidt A.G. of Essen, and Elektrothermit G.m.b.H., also of Essen, and to carry on the business of general and consulting engineers specialising in all methods of welding and allied processes, etc. Solicitors: Bristows, Cooke & Carpmael, 1, Copthall Buildings, E.C.2.

Frozenaire, Ltd.—Registered 5th December. Capital £100. Designers, manufacturers of and dealers in cabinets for refrigerators and electrical appliances of all kinds, etc. Directors: J. J. Miller (chairman) and Mrs. Jean D. Miller. Regd. office: "The Beeches," Old Catton, Norwich.

Allerton Domestic Appliances, Ltd.—Registered 9th December. Capital £1,000. Manufacturers and repairers of and dealers in radio and television sets, electrical and electronic plant, appliances, etc. Directors: D. Blades and E. J. Masser. Regd. office: 17, Wellington Street, Leeds, 1.

Martin Erskine, Ltd.—Registered 10th November. Capital £1,000. Contractors to the electrical trade, radio and television service engineers, etc. Directors: B. M. Hands and D. Argyle. Regd. office: 13, Market Street, Wolverhampton.

M. A. Sterne (Electrical), Ltd.—Registered 10th December. Capital £2,500. To acquire the business of electricians carried on by M. A. Sterne at 62, Bank Street, Newquay, as Electrical Enterprises, etc. Directors: M. A. Sterne and Mrs. Margaret J. Sterne. Regd. office: 44, Fore Street, Newquay, Cornwall.

West Close Electrical Co., Ltd.—Registered 10th December. Capital £1,000. Manufacturers and repairers of and dealers in electrical equipment for motor cars and other vehicles, etc. Directors: I. W. Morgan and E. H. Morgan. Regd. office: 130, Bute Street, Cardiff.

Raidel Services (Mfg.), Ltd.—Registered 6th October. Capital £100. Transformer and coil winders, electrical engineers, etc. Directors: A. C. Perkins and C. G. Warren. Regd. office: 49, Lower Addiscombe Road, Croydon, Surrey.

Andora Lighting, Ltd.—Registered 10th November. Capital £100. Manufacturers of and dealers in electric lamps, fires, stoves, etc. Directors: M. End and W. Wilson. Regd. office: 7, Blackfriars Street, Manchester, 3.

Newlite Installations, Ltd.—Registered 10th November. Capital £2,000. Electricians and manufacturers of and dealers in electrical fittings, etc. Directors: D. B. Newman, Ivy L. Newman, L. W. Chaplin and Dorothy R. Chaplin. Solicitors: A. H. Kent & Co., 27, Old Gloucester Street, W.C.1.

Songhurst (Electrics), Ltd.—Registered 17th December. Capital £100. Electrical and general electrical installation contractors, radio and television engineers, etc. Directors: G. J. Songhurst and Mrs. Eileen E. Cuming. Regd. office: 49, High Street, Croydon, Surrey.

Marshall Hays, Ltd.—Registered 18th November. Capital £2,000. Exporters, importers, manufacturers, repairers and letters on hire of, agents for and dealers in electrical specialities, appliances, apparatus and equipment, dealers in television, radio and electrical goods and appliances, etc. Directors: J. C. Marshall and J. C. Hays. Regd. office: 20, Ridgeway Road, Isleworth, Middx.

Accrington Battery Co., Ltd.—Registered 18th November. Capital £1,000. Manufacturers and repairers of and dealers in electrical accumulators, batteries, acids and containers, dynamos, etc. Directors: F. Howarth and

J. Howarth. Regd. office: 22, Blackburn Road, Accrington.

Multimatic Engineers, Ltd.—Registered 17th November. Capital £5,000. Designers, manufacturers of and dealers in machines, presses, lathes, drilling machines, and machine tools of all kinds, electric motors, electric machines and electrical apparatus, etc. J. Wilkes, junr., is governing director and chairman. Regd. office: 146, Oxford Street, Bilston, Staffs.

Electrical Installations (Uxbridge), Ltd.—Registered 25th November. Capital £100. Electrical engineers and contractors, etc. Directors: D. C. Clarke and Mrs. Margaret Clarke. Regd. office: 31, Myddleton Road, Uxbridge, Middx.

Oxford Electric, Ltd.—Registered 25th November. Capital £1,000. Armature winders, makers of electric motors, dynamos, and electrical and mechanical engineers, etc. Directors: J. T. Makin, A. Newlands, T. Helsby and H. Reece. Regd. office: 1, Rumford Street, Liverpool, 2.

D. & R. Electricals, Ltd.—Registered 25th November. Capital £2,000. Directors: K. W. Roberts and J. C. A. Drew. Regd. office: 1, Oglander Road, S.E.15.

Portlaw Electrics, Ltd.—Registered 28th October. Capital £500. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: W. Portsmouth and J. A. Law. Regd. office: 252, Harrow View, Harrow, Middx.

Isotope Services, Ltd.—Registered 1st December. Capital £100. To conduct research and development in the field of radiology, radiography and electronics generally, and in the application of radioisotopes which can be used in connection with engineering, medicine, chemistry and agriculture, etc. Regd. office: 7, Southwark Street, S.E.1.

Rotel (Great Britain), Ltd.—Registered 1st December. Capital £1,000. Distributors of and dealers in and manufacturers of Rotel products, food mixers, electrical equipment including vacuum cleaners, washing machines, wringers and refrigerators; electricians, radio and television engineers, etc. Directors: F. Horn, H. Goodier and W. Studer. Regd. office: 55, Park Lane, W.1.

Page Engineering Co. (Sunbury-on-Thames), Ltd.—Registered 28th November. Capital £8,000. Designers and manufacturers of and dealers in electrical, mechanical and scientific instruments, dynamos, armatures, etc. Directors: S. J. Telling and L. F. Rayner. Regd. office: 42, Avenue Chambers, Southampton Row, W.C.1.

Woodrow Electrics, Ltd.—Registered 27th November. Capital £100. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: L. J. Woods and R. W. Rowlands. Regd. office: 152, Plumstead Road, S.E.18.

Westwood Appliances, Ltd.—Registered 26th November. Capital £5,000. Manufacturers of and dealers in electrical goods of all kinds, etc. Directors: B. Bentwood, P. A. S. Bentwood and M. T. Edwards. Regd. office: 414, Cheetham Hill Road, Manchester, 8.

Wolverhampton Electric Vehicle Service, Ltd.—Registered 26th November. Capital £1,000. Regd. office: 82, Warstone Road, Wolverhampton.

Elcondux, Ltd.—Registered 3rd December. Capital £100. Electrical engineers and contractors, etc. Directors: J. E. Paige and P. C. Speyer. Regd. office: 120, Wigmore Street, W.1.

W. Byrom, Ltd.—Registered 3rd December. Capital £100. Manufacturers of and dealers in and hirers out and repairers of electrical goods of all kinds, etc. Directors: W. R. Byrom, Mrs. Kathleen D. Byrom and Mrs. Mary Grout. Regd. office: Burghside, Brighton Road, Banstead, Surrey.

F. Webb Electrical, Ltd.—Registered 3rd December. Capital £100. Dealers in and manufacturers of electrical and electronic apparatus, etc. Directors: D. I. Rosenberg and F. Webb. Regd. office: 11, North End Parade, W.14.

Ross Electrical, Ltd.—Registered 4th December. Capital £100. Manufacturers, producers, distributors, importers and exporters of and wholesale and retail dealers in all kinds of electrical and mechanical goods, machinery, motors, dynamos, etc. Solicitor: Kenneth H. Chapman, 15, Curzon Street, W.1.

Brandenburg Precipitators, Ltd.—Registered 4th December. Capital £100. To execute and carry into effect an agreement with F. W. Berk & Co., Ltd., and Brandenburg, Ltd., and to carry on the business of manufacturers of and dealers in electrical and mechanical plant, equipment, apparatus, instruments and devices, etc. Directors: A. C. Wilkinson, D. E. Maclaughlin, B. G. Fletcher and B. E. Mileham. Regd. office: 139, Sanderstead Road, Croydon, Surrey.

F. R. Clarke, Ltd.—Registered 19th November. Capital £1,000. Wholesale electrical factors, etc. F. R. Clarke is the first director. Regd. office: 150a, Ilkeston Road, Nottingham.

Bankruptcies

L. Peel, lately carrying on business at 216, Low Lane, Horsforth, near Leeds, electrical engineer.—Supplemental dividend of 19s 7d in the £, payable on and after 21st January at the Official Receiver's Office, 3rd Floor, Pearl Chambers, East Parade, Leeds, 1.

H. C. Kinsley, electrician, formerly carrying on business as an electrical engineer and contractor under the style of North Lincs Electrical Installations, from 20, Waterloo Street and 42, Queen Street, formerly residing and carrying on business under the same style and under the style of Race Course Filling Station from 74, Willingham Road, all in Market Rasen, Lincs.—Second and final dividend of 3s 5¾d in the £, payable at the Official Receiver's Office, 27, Regent Street, Park Row, Nottingham.

F. W. Mason, trading as F. W. Mason & Son at 20, Shamrock Avenue, Ipswich, electrical contractor and radio and television engineer.—Last day for receiving proofs for dividend 13th January. Trustee, Mr. R. A. Paterson, Archdeacons House, Northgate Street, Ipswich.

E. Bowes, 3, Front Street, Langley Park, Co. Durham, radio and electrical engineer.—First dividend of 13s 4d in the £, payable on and after 15th January at the office of Mr. F. P. Hunnam, 30-32, Grey Street, Newcastle-upon-Tyne.

France's Electrical Trade in 1957

THE French electrical industry, which employs some 256,000 people in 1,746 firms, increased its exports in 1957 by 12 per cent to £54·1 million. As in previous years, these exports were directed mainly to France's overseas possessions (£27·6 million) and the Common Market countries (£7 million). In 1957 France imported electrical goods worth £30·8 million, an increase of 8 per cent over the 1956 figure of £28·7 million, nearly half of which (£14·6 million) came from Common Market countries.

The importance of these countries in France's foreign trade can be seen from Tables 1 and 2, the first also showing the dominant position of West Germany as a supplier of electrical goods. In 1957 no less than 63·7 per cent of France's electrical imports from Common Market countries came from West Germany; and the Union of Belgium-Luxembourg took 37·6 per cent of France's electrical exports to this group. The tables also list France's other principal trade partners, excluding her overseas possessions, and it will be noticed that the main markets are still within Europe and that the principal supplying country is the United States. Imports from the United Kingdom decreased slightly in 1957 to £3·9 million compared with £4·19 million in 1956, whereas exports increased from £733,714 to £1,006,274. As can be seen from Table 3, distribution materials, cables and wires, "static electromagnetic machinery," instruments, radio and TV equipment are the more important products in France's electrical trade.

Table 1.—Electrical Exports: Principal Markets

Country	Value (£000)
Holland	1,830
Belgium-Luxembourg	2,651
West Germany	1,381
Italy	1,160
Total Common Market	7,022
Spain	2,322
Russia	1,955
Turkey	1,371
Portugal	1,151
Sweden	1,094
United Kingdom	1,006
Switzerland	962
Poland	877
Venezuela	875

Table 2.—Electrical Imports: Principal Supplying Countries

Country	Value (£000)
Holland	3,051
Belgium-Luxembourg	1,553
West Germany	9,432
Italy	602
Total Common Market	14,638
United States	9,554
United Kingdom	3,913
Switzerland	2,298
Sweden	477
Denmark	214
Austria	204

Table 3.—Exports and Imports of Principal Products

Product	Value (£000) Exports	Imports
Rotating machinery	3,220	3,512
Static electromagnetic machinery	2,521	2,133
Distribution equipment	4,316	2,402
Installation material	441	1,187
Signalling, safety and control apparatus	192	60
Accumulators (lead)	55	56
Ditto (others)	525	18
Electric vehicles	162	427
Electric traction equipment	388	297
Capacitors	148	462
Domestic appliances	1,192	1,532
Batteries	104	91
Electrical equipment for lifts and hoists	322	237
Electro-medical and radiological apparatus	314	184
Transformers, meters and measuring instruments	2,176	4,589
Insulators, ceramic and parts	444	183
Ditto, glass	131	18
Lighting equipment	322	562
Lamps	341	753
Radio and TV receivers	391	1,133
Ditto, components thereof	1,073	1,610
Radio and TV transmitting equipment	2,521	3,183
Electronic tubes	1,553	2,293
Telegraph, telephone and signalling equipment	1,063	1,066
Wires and cables	3,422	1,182
Insulating material	232	452
Other electrical material, n.e.s.	1,051	1,651

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1954

1153. Elliott Bros. (London), Ltd.—Controlling the speed of a.c. motors for driving gyroscopes. 14th January, 1955. (807065.)

8819. Submarine Cables, Ltd.—Housings for electric submarine repeater apparatus. 25th March, 1955. (806911.)

24581. English Electric Co., Ltd.—Arc chute for circuit-breakers. 19th August, 1955. (807154.)

36051. Yelsen, Ltd.—Electric heater. 13th December, 1955. (807121.)

1955

6374. Smith & Sons (England), Ltd., S.—Electrical indicators. 1st March, 1956. (806913.)

9428. Mullard Radio Valve Co., Ltd.—Cold cathode counter tube circuit arrangements. 16th March, 1956. (806943.)

10456. British Tabulating Machine Co., Ltd.—Electrical apparatus for storing data sensed from record cards. 12th April, 1955. (806873.)

12150. Mullard Radio Valve Co., Ltd.—Transistors. 27th April, 1955. (807042.)

14904. Timberlake, E. J.—Electrical machines. 13th August, 1956. (807122.)

15292. General Electric Co., Ltd.—Gas filled electric discharge devices. 28th May, 1956. (806946.)

15969. Standard Telephones & Cables, Ltd.—Electric discharge devices. 3rd June, 1955. (807123.)

16206. General Electric Co.—Electron discharge devices. 6th June, 1955. (807069.)

16571. Felten & Guilleaume Fernmel-Deanlagen G.m.b.H.—Phase angle measurement. 9th June, 1955. (807162.)

17028. United Kingdom Atomic Energy Authority.—Method of recovery of uranium by a resin-in-pulp process. 13th June, 1955. (807094.)

17307. Film Cooling Towers (1925), Ltd., and Howe, E. A. A.—Water cooling towers. 16th July, 1956. (806884.)

18116. Cossor, Ltd., A. C.—Radar circuits. 20th September, 1956. (807022.)

19463. Branwy Electric, Ltd.—Thermally operated switches. 6th July, 1956. (806957.)

24467. Engelhard Industries, Ltd.—Methods and apparatus for detecting and/or measuring the condensation of oxygen in aqueous liquids such as boiler feed water. 22nd August, 1956. (806918.)

27330. Rotax, Ltd.—Protective means for use in an electric system supplied by a motor driven a.c. generator. 17th December, 1956. (806874.)

27479. Sturtevant Engineering Co., Ltd.—Electrostatic precipitators. 27th September, 1956. (807124.)

30027. Corning Glass Works.—Machines for sealing electrically conductive button elements into glass envelopes. 20th October, 1955. (806921.)

33079. Western Electric Co., Inc.—Velocity modulation apparatus and electron guns therefor. 18th November, 1955. (806890.)

34839. Technical Ceramics, Ltd.—Electrical components and method of making same. 5th December, 1955. (807019.)

35601. British Thomson-Houston Co., Ltd.—Dynamo-electric machines. 4th December, 1956. (Cognate application 3212, 1st February, 1956.) (806947.)

36003. International Business Machines Corporation.—Control systems including analogue-to-digital convertors. 15th December, 1955. (806892.)

36886. Siemens-Schuckertwerke A.G.—Semi-conductor bodies. 23rd December, 1955. (806923.)

1956

60. Compagnie Française Thomson-Houston.—Voice transmission systems. 2nd January, 1956. (806924.)

195. General Electric Co., Ltd.—Thermal electric cut-outs. 3rd January, 1957. (807001.)

1993. Standard Telephones & Cables, Ltd.—Cathode-ray amplifier. 20th January, 1956. (807097.)

3071. Philips Electrical Industries, Ltd.—Lighting devices comprising a part made of glass. 31st January, 1956. (807133.)

3952. General Electric Co.—Thermionic electron emitting devices. 8th February, 1956. (806893.)

4093. General Electric Co.—Room air conditioning apparatus. 9th February, 1956. (807098.)

4255. British Thomson-Houston Co., Ltd.—Control of electric motors. 15th January, 1957. (806948.)

7784. Rotax, Ltd.—Protective apparatus for electric current distributing systems. 1st March, 1957. (807125.)

8390. Mullard Radio Valve Co., Ltd.—Cold cathode counter tube circuit arrangements. 16th March, 1956. (Divided out of 806943.) (806944.)

8555. British Insulated Callender's Cables, Ltd., and Telegraph Condenser Co., Ltd.—Printed circuits. 18th June, 1957. (806977.)

9006. General Electric Co., Ltd.—D.c. motor systems. 24th June, 1957. (806978.)

9360. Siemens Edison Swan, Ltd.—Selector systems. 15th March, 1957. (807126.)

17176. Clevite Corporation.—Electrical switches. 4th June, 1956. (807170.)

17900. Taylor Stamping Works, Ltd., E.—Electric lamps. 6th June, 1957. (806899.)

18827. British Thomson-Houston Co., Ltd.—Carrier wave communication systems. 18th June, 1957. (806901.)

19034. Westinghouse Electric International Co.—Cathode-ray tubes and screens therefor. 20th June, 1956. (807106.)

19258. Sunvic Controls, Ltd.—Presentation and display of heat exchanger gas activity information in graphite moderated power reactors. 16th May, 1957. (807048.)

21340. General Motors, Ltd.—Controllers for split-phase electric motors. 21st June, 1957. (806983.)

22004. English Electric Co., Ltd.—Charge tube sealing plugs for nuclear reactors. 11th July, 1957. (806984.)

22021. United Kingdom Atomic Energy Authority.—Cooling systems for heterogeneous nuclear reactors. 15th July, 1957. (806985.)

22524. General Electric Co.—Electric incandescent lamps. 20th July, 1956. (807137.)

23642. Scully Signal Co.—Electrical fail-safe systems. 31st July, 1956. (807033.)

25858. M-O. Valve Co., Ltd., and Willshaw, W. E.—Electronic tubes for use as backward wave oscillators. 23rd August, 1957. (807127.)

33263. Andvig, J.—Clip for fastening electric conductors. 31st October, 1956. (806988.)

1957

1934. Philips Electrical Industries, Ltd.—Colour television picture tubes. 18th January, 1957. (807129.)

3816. Sylvania Electric Products, Inc.—Fuse for electric incandescent lamp. 4th February, 1957. (806967.)

12719. Standard Telephones & Cables, Ltd.—Variable frequency oscillators. 18th April, 1957. (806996.)

12749. Babcock & Wilcox, Ltd.—Tubulous vapour generators. 18th April, 1957. (806997.)

14672. Sulzer Freres S.A.—Inhibition of corrosion in steam turbine power plants. 8th May, 1957. (807187.)

15145. Fiat S.p.A.—Regulation set for electric generators on motor vehicles. 13th May, 1957. (806998.)

15589. Babcock & Wilcox, Ltd.—Waste heat boilers and a method of operation therof. 16th May, 1957. (807059.)

35691. British Thomson-Houston Co., Ltd.—Electric insulating bushing assemblies. 15th November, 1957. (806955.)

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 17th January:—

Amp (design). No. 766,044. Class 7. Machines and machine tools all for coding, stamping and crimping electrical terminals, for stripping insulation coverings from wire and for attaching steel bands and electrical terminals to wire; and crimping heads, dies and die inserts.—Amp Incorporated, Harrisburg, Penn., U.S.A. Address for service, c/o Urquhart-Dykes & Lord, Maxwell House, 11, Arundel Street, Strand, London, W.C.2.

Aurora. No. 776,014. Class 9. Kits of parts (sold complete) for assembling into telegraphic signalling apparatus, telephonic apparatus and into radio sets; ear pieces for use with these goods; and battery eliminators.—Aurora Plastics Corporation, West Hempstead, Long Island, N.Y., U.S.A. Address for service, c/o Baron & Warren, 16, Kensington Square, London, W.8.

Instam. No. 777,893. Class 9. Electrical instruments for indicating the use of television or radio sets by means of electrical impulses; and electrical apparatus and instruments for transmitting, receiving and recording such impulses.—Television Audience Measurement, Ltd., Kingshill, Berkhamsted, Herts.

Electromatic. No. 779,543. Class 9. Electrical instruments for use in vehicles.—Kienzle Apparate G.m.b.H., Villingen/Schwarzwald, Germany. Address for service, c/o Matthews Haddan & Co., 31-32, Bedford Street, Strand, London, W.C.2.

Hotpoint Hi-Speed. No. 779,822. Class 9. Domestic electrical appliances and parts.—Hotpoint Electric Appliance Co., Ltd., Crown House, Aldwych, London, W.C.2.

Bake-O-Mat. No. 779,918. Class 9. Electrical apparatus and instruments, and parts. **Bake-O-Mat.** No. 779,919. Class 11. Electrical installations for baking, and parts.—Rotiss-O-Mat, Ltd., 101, Farm Lane, Fulham, London, S.W.6.

Media. No. 780,891. Class 9. Electric switchgear.—Revo Electric Co., Ltd., Britannia Works, Groveland Road, Tividale, Tipton, Staffs.

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NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

MONDAY, 12th JANUARY

Birmingham.—College of Technology, Gosta Green, 6 p.m. I.E.E. South Midland Supply and Utilisation Group. "Recent Developments in Medium-Voltage High-Breaking-Capacity Fuse Links," by R. H. Dean.

Bournemouth.—Grand Hotel, Firvale Road, 8 p.m. A.S.E.E. Bournemouth Branch. Films.

Cardiff.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Centre. "The Design of the 330 kV Transmission System for Rhodesia," by F. C. Winfield, T. W. Wilcox and G. Lyon.

Leeds.—At the British Lighting Council, 24, Aire Street, 1, 6.15 p.m. I.E.S. Leeds Centre and E.A.W. Forum on Home Lighting.

London.—Savoy Place, 5.30 p.m. Institution of Electrical Engineers. Informal meeting. Discussion on "What is the Economic Limit of Mechanical Aid to Field Work?" opened by P. F. Clark.

White Hall Hotel, Bloomsbury Square, W.C.1, 7.15 p.m. A.S.E.E. Central London Branch. "Floor-warming Today," by L. Shepherd.

Malvern.—Winter Gardens, 7.30 p.m. Combined meeting of I.E.E. South Midland Radio and Measurement Group and Malvern and District Group. "Electrostatic Loud Speakers," by P. J. Walker.

Newcastle-on-Tyne.—Neville Hall, Westgate Road, 6.15 p.m. I.E.E. North Eastern Centre. "The Design and Performance of the Gas-Filled Cable System," by E. P. G. Thornton and D. H. Booth.

Sheffield.—Department of Mining, University of Sheffield, Mappin Street, 6.30 p.m. I.E.S. Sheffield Centre. "Mine Lighting Problems," by A. Roberts, W. J. Wellwood Ferguson, A. G. Neill and B. N. Clarkson.

Stoke-on-Trent.—Grand Hotel, Hanley, 7.30 p.m. Institution of Production Engineers, North Western Region. "Electronic Computer Control of Machine Tools," by H. Ogden.

Wembley.—Century Hotel, Forty Avenue, 8.15 p.m. A.S.E.E. North West London Branch. 1958 Exhibition film, presented by P. A. Thorogood.

TUESDAY, 13th JANUARY

Belfast.—Civil Engineering Department, Queen's University, 6.30 p.m. I.E.E. Northern Ireland Centre. "The Use of Steel-Tank Mercury-Arc Invertors for Generating Medium Frequencies for Induction Heating," by D. L. Smart and J. J. L. Weaver.

Birmingham.—The Engineering Centre, Stephenson Place, 6.30 p.m. Institution of Heating and Ventilating Engineers, Birmingham and District. "Engineering Services in the Empire Games Pool, Cardiff," by J. R. Kell.

Bristol.—The University, 7 p.m. I.E.E. Bristol Graduate and Student Section. "Fundamentals of Transistors," by I. B. V. Frost.

Cardiff.—A.S.E.E. South Wales Branch. Visit to G.P.O. Automatic Exchange.

Coventry.—Coventry Electricity Sports and Social Club, Merrick Lodge, St. Nicholas Street. Coventry Electric Club. "The Development of Firearms," by W. H. Smith.

Edinburgh.—Lyceum Gallery, Atholl Crescent. I.E.S. Edinburgh Centre and Edinburgh Electrical Society. Joint meeting.

Eltham.—Eltham Green School, Queenscroft Road, S.E.9, 7.45 p.m. A.S.E.E. South East London Branch. "Railway Electrification," by A. Norton.

Glasgow.—Institution of Engineers and Shipbuilders, 7.30 p.m. Plastics Institute and Institution of the Rubber Industry, Scottish Section. "The Moulding and Forming of High-Density Polyethylene," by R. Hayes.

Leeds.—C.E.G.B., 1, Whitehall Road, 7 p.m. I.E.E. North Midland Graduate and Student Section. Main Centre Chairman's address, by J. D. Nicholson.

London.—Savoy Place, W.C.2, 6.30 p.m. I.E.E. London Graduate and Student Section and Education Discussion Circle. Discussion on "Education and Training from the Student's Point of View."

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club. Luncheon.

The Memorial Building, 76, Mark Lane, E.C.3, 5.30 p.m. Institute of Marine Engineers and Institution of Naval Architects. "The Development of Air Conditioning in Ships," by S. J. Jones and J. K. W. MacVicar.

At the Federation of British Industries, 21, Tothill Street, S.W.1, 6 p.m. Illuminating Engineering Society. "Designed Appearance Lighting of Gloucester Cathedral," by J. M. Waldram.

Loughborough. — Loughborough College, 6.30 p.m. I.E.E. East Midland Centre. "Results of Full-Scale Stability Tests on the British 132 kV Grid System," by Dr. F. Busemann and W. Casson.

Manchester.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North Western Utilisation Group. "The 'Deltic' Locomotive," by C. M. Cock.

Engineers' Club, Albert Square, 7.15 p.m. Incorporated Plant Engineers. "Industrial Law and the Plant Engineer," by C. N. Glidewell.

Portsmouth.—At the Ministry of Labour and National Service, Lake Road, 7.30 p.m. A.S.E.E. Portsmouth and District Branch. "Welding."

Sheffield.—Grand Hotel, 7 p.m. E.P.E.A. Sheffield Technical Group. "Developments in Railway Electrification," by J. A. Broughall.

Workington.—College of Further Education, 7 p.m. I.E.E. North Eastern Centre. "The Design and Performance of the Gas-Filled Cable System," by E. P. G. Thornton and D. H. Booth.

York.—"Georgian House," Blossom Street, 7.30 p.m. A.S.E.E. York Branch. "Silicones and their Applications."

WEDNESDAY, 14th JANUARY

Birmingham.—James Watt Memorial Institute, 6.30 p.m. I.E.E. South Midland Graduate and Student Section. Students' lecture. "Something for Nothing? Heat Pump Achievements," by G. O. McLean.

Engineering Centre, Stephenson Place, 7.30 p.m. A.S.E.E. Birmingham Branch. "The National Inspection Council—Its Aims and Objects," by E. W. Roper.

Bradford.—Midland Hotel, 7.30 p.m. A.S.E.E. Bradford Branch. "Ball Bearings," by J. Warren.

Bristol.—Grand Hotel, Broad Street, 7.15 p.m. Incorporated Plant Engineers, Western Section. "Nuclear Energy," by Dr. M. D. Wood.

Cardiff.—College of Advanced Technology, 6.30 p.m. British Institution of Radio Engineers, South Wales Section. "Computer Control of Machine Tools," by H. Ogden.

Glasgow.—39, Elmbank Crescent, C.2, 8 p.m. A.S.E.E. Glasgow Branch. "H.V. Cable Manufacture and Uses."

Leeds.—Hotel Metropole, 11 a.m. Combustion Engineering Association, Northern Region. "Mechanical Handling, Storage, Conditioning of Solid Fuels," by W. G. Archer.

London.—Lecture Theatre, Royal Institution, 21, Albemarle Street, W.1, 5.30 p.m. Institute of Physics, London and Home Counties Branch. "Controlled Thermonuclear Reactions," by Sir George Thomson.

Manson House, Portland Place, W.1, 6 p.m. Society of Instrument Technology. London Meeting. Symposium on Storage Media.

Luton.—Chamber of Commerce, George Street West, 8 p.m. A.S.E.E. Luton Branch. "Flameproof Installations," by S. J. Emerson.

Manchester.—Engineers' Club, 2.30 p.m. Combustion Engineering Association, North Western Region. Brains Trust on "The Working of the Clean Air Act."

Newcastle-upon-Tyne.—Neville Hall, Westgate Road, 6 p.m. British Institution of Radio Engineers, North Eastern Section. "The Design and Construction of an Electronic Digital Computer," by R. W. Walker.

Northampton.—Room B.16, College of Technology, 7.15 p.m. Northampton and District Electrical Association. "Design of Large Electrical Installations," by W. H. Brooks.

Nottingham. — County Hotel, Theatre Square, 7 p.m. Incorporated Plant Engineers. "A Criticism of Technical Education," by Dr. H. L. Haselgrave.

Preston.—North Western Electricity Board, Friargate, 7.15 p.m. I.E.E. North Lancashire Sub-Centre. "British Columbia-Vancouver Island 138 kV Submarine Power Cable," by Dr. T. Ingledow, R. M. Fairfield, E. L. Davey, K. S. Brazier and J. N. Gibson.

Wolverhampton.—M.E.B. Showrooms, Darlington Street, 7.45 p.m. A.S.E.E. Wolverhampton and District Branch. "Floor Warming," by S. C. Dineage.

THURSDAY, 15th JANUARY

Blackburn.—White Bull Hotel, 7.30 p.m. Incorporated Plant Engineers. "Education," by Ven. C. H. Lambert.

Cardiff.—Park Hotel, 7 p.m. South Wales Institute of Engineers. Annual dinner.

Derby.—Electricity Showrooms, 7 p.m. Society of Instrument Technology, East Midland Section. "Railway Signalling Development," by J. S. S. Davis.

Dublin.—Trinity College, 6 p.m. I.E.E. Irish Branch. "Probability and Statistics in Engineering Problems," by Dr. M. D. McCarthy.

Glasgow.—29, St. Vincent Place, 6.30 p.m. I.E.S. Glasgow Centre. "An Analytical Approach to Industrial Lighting," by W. Imrie-Smith.

Leeds.—St. Marks House, 186, Woodhouse Lane. Plastics Institute, Yorkshire Section. "Commercial Radiography."

London.—Savoy Place, 5.30 p.m. I.E.E. Utilisation Section (in conjunction with the British Nuclear Energy Conference). "Electrical Installation at Calder Hall Nuclear Power Station," by N. J. Mackay and E. Hardwick.

76, Mark Lane, E.C.3, 2.30 p.m. Diesel Engineers' and Users' Association. "Multi-Fuel High Speed Diesel Engines," by H. L. Troughton and R. L. Fowler.

FRIDAY, 16th JANUARY

Leeds.—Queen's Hotel. Incorporated Plant Engineers, West and East Yorkshire Section. Annual dinner-dance.

London.—Café Royal, 7 for 7.30 p.m. I.E.E. Utilisation Section. Dinner-dance.

Savoy Place, W.C.2, 6 p.m. I.E.E. London Graduate and Student Section. "Frontiers of Space Research," by Dr. R. M. Page.

Criterion, Piccadilly, W.1. Plastics Institute, London and District Section. Annual dance.

Caxton Hall, Westminster, S.W.1, 6.30 p.m. E.P.E.A. Meter Engineers' Technical Group. "Metering the Ever-Changing Tariff," by M. L. Done and S. Wrigley.

14, Rochester Row, Westminster, S.W.1, 7 p.m. Junior Institution of Engineers. "Engineering Uses of Epoxy Resins," by R. Land.

Stoke-on-Trent.—Technical College, 7 p.m. I.E.E. North Staffordshire Sub-Centre. "Operational Experience at Calder Hall," by K. L. Stretch.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—State Electricity Commission of Western Australia, Perth. 5th February. Carrier protection equipment. (E.S.B. 31225/58. Ten/36477.)*

Snowy Mountains Hydro-Electric Authority, Cooma North. 27th February. Submersible motorised pumps and accessories. (E.S.B. 31475/58. Ten/36456.)*

Victorian Railways, Melbourne. 21st January. Insulated cable. (E.S.B. 31787/58. Ten/36520.)*

Commonwealth Department of Supply, Melbourne. 22nd January. 300 kW generating plants to R.A.A.F. Works Equipment Specification W12. (E.S.B. 31785/58. Ten/36522.)*

State Electricity Commission of Victoria, Melbourne. 28th January. Transformers and spares. (E.S.B. 31799/58. Ten/36519.)*

Queensland Railways, Brisbane. 20th February. Railcars. (E.S.B. 31650/58. Ten/36493.)*

Bradford.—City Council. 11th February. Four automatically controlled electrically driven pumping units, including the provision of automatic starting and control gear and electrical wiring. Sewage works engineer and manager, Esholt Hall, near Shipley, Yorks.

Bushey.—U.D.C. 30th January. Street lighting equipment. (See this issue.)

Dunsford (Co. Down).—16th January. Electrical installation in St. Mary's Primary School. C. P. McNally, 143, Royal Avenue, Belfast.

Heston and Isleworth.—Corporation. 30th January. Street lighting improvements. (See this issue.)

India.—Singareni Collieries Co., Ltd., Hyderabad. 15th January. 200 kVA and 300 kVA transformers. (E.S.B. 31521/58. Ten/36449.)*

Madras State Electricity Board. 16th January. Transformers. (E.S.B. 31786/58. Ten/36517.)* 20th January. 66 kV metering equipment. (E.S.B. 31374/58. Ten/36450.)*

Damodar Valley Corporation, Calcutta. 6th February. Air conditioning plant for Durgapur power station. (E.S.B. 31199/58. Ten/36418.)*

Iran.—S/S Sugar Factories of Iran, Teheran. 9th February. Electric lamps. (E.S.B. 31356/58. Ten/36436.)*

Manchester.—City Council. 19th January. Electrical installations in shops, maisonnettes and garages at Langley, Middleton. City architect, P.O. Box 488, Town Hall.

4th February. Hand and electrically operated valves and penstocks, Davyhulme sewage works extensions. City surveyor, Town Hall, 2.

New Zealand.—G.P.O., Wellington. 26th January. Capacitors. (E.S.B. 31448/58. Ten/36453.)* 4th February. Radio test equipment. (E.S.B. 31775/58. Ten/36528.)*

Pakistan.—Posts and Telegraphs Department, Karachi. 20th January. Cord conductors and plugs. (E.S.B. 31976/58. Ten/36546.)*

Rhodesia and Nyasaland.—Que Que Electricity Department. 23rd January. 11 kV cable. (E.S.B. 31814/58. Ten/36513.)*

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Electricity Supply Commission, Salisbury. 29th January. Circuit-breakers and line sectionalisers. (E.S.B. 31813/58. Ten/36538.)*

South Africa.—Johannesburg City Council. 15th January. E.h.v. cubicles and protective current transformers. (E.S.B. 31610/58. Ten/36480.)*

Surrey.—County Council. 2nd February. Street lighting equipment. (See this issue.)

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Bangor (North Wales).—Teaching block for college; C. W. Glover & Partners, architects, Francis House, Francis Street, London, S.W.1.

Barrow-in-Furness. — Twin operating theatre suite for North Lonsdale Hospital; Manchester Regional Hospital Board, Cheetwood Road, Manchester, 8.

Birmingham.—Research laboratories, Warwick Street; Alfred Bird & Sons, Ltd., Deritend.

Bishop's Stortford.—Extensions to Herts and Essex College; John Willmott & Sons, Ltd., builders, Walsworth Road, Hitchin.

Bournemouth.—Flats (32), Arthur Close; A. G. Jessopp Bros., Ltd., Portland Road, Winton.

Bury.—Community centre, civic building, shops, etc., at Sunny Bank; J. Chadwick, borough engineer, Bank Street.

Cardiff.—Secondary modern school, Ty Celyn estate; city architect, 12, Park Place.

Cheltenham.—Works extensions; Douglas Equipment, Ltd., Kingsditch Lane, Tewkesbury Road.

Devonport.—Workshop block for Technical College; Dudley Coles, Ltd., builders, Bath Street, Plymouth.

Dorchester.—Houses (100) for staff of U.K. Atomic Energy Authority; W. G. Taylor & Sons, builders, 3, Custom House Quay, Weymouth.

Durham.—Pithead baths: Clara Vale Colliery; D. Crouch, Ltd., builders, Birtley. Emma Colliery; Gordon Durham & Co., builders, East Boldon.

East Wickham.—Dwellings (165); J. Anderson & Sons, Ltd., 227, Court Road, Orpington.

Epsom.—Houses (60), Ruxley Farm estate; borough surveyor.

Exeter.—Houses (69); city architect, Municipal Offices.

Eye (Suffolk).—Rest room block, Hartismere Hospital; L. Hyams, architect to East Anglian Regional Hospital Board, 29, Elm Street, Ipswich.

Fleetwood.—Houses (42), south of Hodder Avenue; borough surveyor, Fleetwood, Lancs.

Frimley.—Houses (120), Rorke's Drift estate; Fredk. J. Minns & Co., Ltd., Botley Road, Oxford.

Gateshead.—Houses (66), Chowdene Hall Farm estate; Hadden & Hillman, builders, 127, New Bridge Street, Newcastle-on-Tyne.

Gosforth (Northumberland).—Blocks of flats (69), Coxlodge; U.D.C. surveyor.

Guisborough.—Completion of ward block at Guisborough General Hospital for Newcastle Hospital Board (£60,000); N. Thompson, Ltd., builders, Stonehouse Street, Middlesbrough.

Hartlepool.—Community centre, Miers Avenue; J. Wilkin, borough engineer.

Hatfield.—Works extensions; Chrome-Alloying, Ltd., Birchwood industrial estate.

Ilford.—Multiple store, Ley Street; North & Partners, architects, 40, Broadway, Maidenhead.

King's Lynn.—Works extension; Beaulahs (King's Lynn), Ltd., The Docks.

Kirkcaldy.—Erection of large extension to Victoria Hospital (£600,000); South Eastern Regional Hospital Board, 18, Rothesay Terrace, Edinburgh, 3.

Lancaster.—Houses (434), Main Street redevelopment; J. D. Waddell, town clerk, Town Hall.

Launceston.—Flats (34), Hurdon Way; borough engineer.

Liverpool.—Three blocks of multi-storey flats, Garibaldi Street; city architect.

London.—Multi-storey offices, Queen Street and Watling Street, E.C.; H. Fitzroy Robinson, architect, 3, Gray's Inn Square, W.C.1.

Dwellings (175), Cottage Street, Poplar; W. J. Simms, Sons & Cooke, Ltd., builders, Beddington Lane, Croydon.

Showrooms and offices, 149, Oxford Street; Walter Gladding & Co., Ltd., builders, 14, Davenant Street, W.1.

Office block, Knightsbridge; Myton, Ltd., builders, Western House, Western Avenue, W.5.

North Cotswold.—Houses (58); surveyor, Council Offices, Moreton-in-Marsh, Glos.

North Shields.—Factory extension (7,000 sq ft) for Dukes & Markus, gown manufacturers, West Chirton trading estate.

Ormskirk.—Dwellings (66), Truscott estate; Berry & Hellowell, Ltd., builders, Liverpool Road North, Burscough.

Richmond (Surrey).—Flats (42), North Road, Kew; borough surveyor, Hotham House, Heron Court.

Romford.—Factory extension; Pagan, Ltd., Faringdon Avenue, Harold Hill.

St. Helens.—Houses (140), Chancery Lane, and flats (24), Derbyshire Hill; M. Ward, borough engineer, Town Hall.

Scarborough.—Flats (75); borough engineer.

Seaton Valley.—Houses (36), Klondyke; T. W. Burgess, U.D.C. surveyor.

Slough.—Extensions to British Home Stores, Ltd., High Street; H. Fairweather & Co., Ltd., builders, Hyde Works, St. James's Lane, London, N.10.

Southport.—Factory, Meols Cop Road; Arnold Kinnings & Sons, Ltd., Norwood Road.

Street (Somerset).—First section of scheme for an area college (£94,000); R. O. Harris, county architect, Park Street, Taunton.

Stroud.—Houses (89); surveyor, John Street, Stroud, Glos.

Surbiton. — Dwellings (22), Raeburn Avenue; Speirs, Ltd., builders, 66, Victoria Street, London, S.W.1.

Tavistock.—Old people's home, Plymouth Road (£78,000); Devon county architect, 97, Heavitree Road, Exeter.

Teignmouth.—Erection of a combined conference hall and theatre in Carlton Place (£45,000); surveyor, Bitton Park.

Tynemouth.—Proposed factory on the North Shields-Wallsend boundary, for Thames Board Mills, Ltd., London (£4,000,000).

Wigston.—Public swimming bath (£75,000); clerk, Urban Council Offices, Wigston, Leicester.

York.—Houses (81), Low Field estate; E. Firth, city architect, 8, St. Leonard's Place.